CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Fuel Farm UST Remedial Investigation Draft Work Plan

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SECTION 1 INTRODUCTION

ERM Program Management Company (ERM), Exton, Pennsylvania has prepared this Work Plan for investigation of potential soils and groundwater contamination from underground storage tanks (USTs) located at the Fuel Farm at SUBASE, New London. The plan was prepared as Project No. 6 under NAVFAC Contract No. N62472-91-D1405.

1.1 BACKGROUND AND PURPOSE

The SUBASE is located on the east bank of the Thames River approximately five miles north of Long Island Sound. The investigation area lies at the southern end of the SUBASE in the UST farm. Nine concrete underground storage tanks (OT-1 through OT-9) were constructed in 1942 in an area formerly occupied by a shallow lake (Crystal Lake). The tanks were used for storage of No. 6 fuel oil, diesel, and waste oil.

Evidence of releases of petroleum products from these tanks and their associated piping and, possibly, from other nearby sources has been detected during previous investigations (see Section 1.7). Both soil and groundwater contamination have been identified but have not been fully characterized as to their extent and impact in the subject area. An outfall for a storm water discharge system in nearby Goss Cove, has yielded petroleum hydrocarbons on a number of occasions (see Section 1.7).

The purpose of the proposed scope of work is to define the full extent of soil and groundwater contamination in the UST farm, evaluate the impacts of the UST farm on the stormwater discharge and develop preliminary recommendations for remedial action, should it be necessary.

1.2 SITE DESCRIPTION

The UST farm is located at the southern end of the Naval SUBASE, Groton, Connecticut (see Figure 1) and covers an area of approximately 35 to 37 acres. Tank farm features include the following:

- Eight 110-foot diameter, 11-foot high fuel oil USTs;
- One former 110-foot diameter, 11-foot high fuel oil UST site (OT-6);
- A 30,000-gallon double walled UST (OT-10);
- An oil/water separator;

- A fuel oil loading rack;
- Associated UST piping systems;
- The MWR Recreation Center (building #461);
- Six baseball fields; and
- A restroom facility (building #445).

East of the tank farm are two high rise barracks (Buildings #442 and #447). The site is bounded to the south by Crystal Avenue. Located on Crystal Avenue are four rental units, a long-term parking facility, and a dry cleaning facility.

The base command building (building #138), legal services (building #137) and public works (Building #135) lie to the west. The tank farm is bounded on the north side by Tang Avenue. A carpentry and maintenance building (building #406), the NEX department store and grocery store, and the Naval Exchange (NEX) gasoline Service Station (Buildings #408, #409, and #410). are located on the north side of Tang Avenue. Six baseball fields and a number of parking areas are located above the tank farm at the ground surface.

Product Transfer Lines

Product was historically delivered via barge to a pier where it was pumped via pipelines to the USTs through the Building #79 valve house. Product was transferred via pipeline from the USTs to the power plant or the submarines on an as-needed basis.

The No. 6 oil transfer lines are situated within lined trenches. The diesel lines have no trenches. Currently, neither set of lines is cathodically protected. The ages of the No. 6 oil lines are unknown (possibly original lines) and the diesel lines are approximately eleven years old.

Existing Storm Drainage System

The UST farm contains an extensive drainage system consisting of numerous catch basins, perforated metal corrugated pipe (PMCP), and vitrified clay pipe. The drainage system appears to have been installed with PMCP to depress the water table by allowing groundwater to collect and discharge to Goss Cove. The actual elevation of this drainage system is not known, however, a review of SUBASE drawings indicates that it was installed below the process piping.

The central drainage line of this system (constructed of PMCP) is known to be corroded. The SUBASE attempted to video tape the line, but could

not move the camera assembly through the line. The SUBASE is planning to replace the line and has already completed a redesign of the system.

According to SUBASE personnel, the drainage system serves approximately one-third of the entire facility. As such, numerous opportunities for contaminants to enter the system potentially exist. Note that this type of system is not water tight and is designed to allow water to enter through the piping and joints.

Tank Underdrain System

The nine tanks are each rated for a nominal capacity of 750,000 gallons or approximately 100,000 cubic feet. Each tank is approximately 110 feet in diameter. Underground storage tanks of this type are usually designed and constructed with a permanent groundwater drainage system to prevent the tank from floating out of the ground under hydraulic pressure. Floating can occur when a tank with a wide floor perimeter, constructed below the water table, is emptied.

Groundwater in some areas of the site may be as little as two feet below grade. Groundwater at a depth of two feet would convert to a hydraulic pressure of 2.6 pounds per square inch exerted over the entire floor of one empty tank, or an upward force of approximately 1,400 tons. The floor of the tank would rise, with or without its walls. This condition is typically resolved using a site wide drainage system, pop-up valves, or underdrain system. It appears that a site wide drainage system is in place for this purpose, however, it is not clear if pop-up valves or underdrains were incorporated in the design of the USTs.

Pop-up valves are groundwater relief valves constructed in the floor of the tank. When the contents of the tank are removed and the hydraulic pressure from the groundwater exceeds the static pressure in the tank, the weighted valves rise, allowing groundwater to enter the tank. This continues as product is removed to maintain an equalized pressure at the tank floor and thus prevent it from rising.

Another typical system is a series of underdrains. Perforated pipe is installed under the tank and surrounded by a stone filter media. Groundwater is diverted from under the tank to a convenient discharge point. Since the preliminary data shows groundwater levels at approximately elevation 18.0 feet in the vicinity of the tanks, some type of mechanism is preventing the tanks from floating. This mechanism may be allowing contaminated water to be continuously discharged into Goss Cove.

1.3 *UST HISTORY AND FUTURE PLANS*

The underground fuel storage facility was constructed in the former location of Crystal Lake. In the early 1940s, Crystal Lake was drained and dredged to allow for construction of the nine concrete underground storage tanks. When construction was complete, the former lake was reportedly filled with soils excavated from a small hill west of the tank area and graded to create a level surface for development of the SUBASE.

Each of the nine USTs has a holding capacity of 750,000 gallons. No. 6 fuel oil was stored in tanks OT-1 through OT-3 from the date of construction until removed from service in the summer of 1991. Tanks OT-7 through OT-9 were decommissioned in the summer of 1990 and were used exclusively for storage of diesel during all 48 years of service.

A reduced SUBASE demand for diesel in the mid-1970s led to the decommissioning and demolition of tank OT-6. Details regarding demolition procedures were not on file at the SUBASE. The reduced demand for diesel also led to the modification of tanks OT-4 and OT-5 for waste oil storage purposes. Tank OT-4 was used to store tank bottom wastes from OT-1. Tank OT-5 was used as part of an oil/water separator system. Both tanks were reportedly decommissioned after the installation of a new 30,000-gallon waste oil tank (OT-10) in 1990.

Current plans call for the four diesel tanks to be abandoned in 1993 (USTs OT-4, OT-7, OT-8 and OT-9). Tank OT-5 which has an associated PCB contamination problem currently under investigation is to be closed in 1992 The remaining tanks in the UST farm are scheduled for closure within the next two years.

1.4 *HISTORY OF PETROLEUM SPILLS*

A number of petroleum spills have been documented by the Department of the Navy. Each incident described in Navy spill reports is listed below.

- August 28, 1989 - Oil was discovered in an excavation for new waste oil tank OT-10. The source of the oil was determined to be the French drain around adjacent waste oil tank OT-5 located adjacent to the excavation. As per Connecticut Department of Environmental Protection (CTDEP) regulations, a spill report was filed and the tank was removed from service. Oil present in the excavation for tank OT-10 was pumped out and disposed of off site. There is no indication that samples were collected or that soil was removed.

- January 1990 - Waste oil collection tank overflowed during rain storm due to inoperative controls. Oil/water mixture entered the storm drainage system and discharged into permanently boomed area at storm sewer outfall. Approximately 14.6 gallons of petroleum were recovered by the Navy's Oil Spill Response Team (NOSRT).

- April 1990 - Hydraulic oil mixture and creosote discovered at outfall of storm drainage system. Approximately 0.5 gallons of petroleum recovered by NOSRT.

- May 1990 - Hydraulic oil mixture and waste oil discovered at outfall of storm drainage system. Approximately 1.5 gallons recovered by NOSRT.

- June 1990 - Hydraulic oil mixture and diesel fuel mixture discovered at outfall of storm drainage system. Approximately 1.5 gallons of petroleum recovered by NOSRT.

- July 1990 - Hydraulic oil mixture discovered at outfall of storm drainage system. Approximately 11.5 gallons of petroleum recovered by NOSRT.

- August 1990 - Mixture of No. 6 fuel oil, hydraulic oil, and diesel discovered at outfall of storm drainage system. Approximately 4 gallons of petroleum recovered by NOSRT.

- August 1990 - Rupture of oil line in SUBASE oil pit No. 1 (located near tank OT-1). Heavy rains caused No. 6 fuel oil to enter drainage system and discharge into permanently boomed area at storm sewer outfall. Approximately 14.6 gallons of petroleum recovered by NOSRT.

1.5 *SITE GEOLOGY*

Soils encountered in the underground tank area during the installation of monitoring wells by ERM in 1991 consisted of very fine to medium sand with a trace of silt and gravel. In general, the subsurface material appeared to consist of fill and reworked native soils.

Bedrock was not encountered during the installation of monitoring wells by ERM. Based on published information, bedrock in the Groton area is believed to exist at a depth of between 75 and 92 feet below the ground surface.

1.6 *SITE HYDROLOGY*

Groundwater in the underground tank farm occurs under water table conditions at a depth of approximately 2.5 to 6 feet below grade. Groundwater elevation data collected by ERM during a limited investigation of the tank farm in 1991 indicate that the water table fluctuates an average of 1-foot on a seasonal basis. The greatest amount of fluctuation (approximately 1.5 feet) occurred in wells located near tank OT-8. The water table elevation at wells located adjacent to Tang Avenue fluctuated by as little as 0.07 feet seasonally.

Groundwater in the western portion of the underground tank farm appears to flow from the north, east, and south toward a trough in the water table. The presence of a trough in the water table has been apparent since the addition of new monitoring wells (ERM 1 through ERM-19) by ERM during May 1991. Groundwater in the eastern portion of the tank farm appears to flow to the northeast toward tanks OT-4 and OT-5. However, data regarding groundwater conditions in areas north and east of tank OT-7 is limited as a result of significant gaps in coverage of the existing monitoring well network.

1.7 *PREVIOUS INVESTIGATIONS*

Diesel Tank Investigation: In June 1989 Fuss and O'Neill, Inc. (F&0) was contracted by the Department of the Navy to perform a soil and groundwater investigation near diesel storage tanks OT-4, OT-7, OT-8, and OT-9. The investigation was conducted at the request of the CTDEP to confirm that the tanks were intact and leakage was not occurring. Prior to the investigation, the CTDEP had recommended that the tanks be decommissioned due to their age. As an alternative, an agreement was reached between the Navy and CTDEP which would allow the tanks to remain in service pending the outcome of the F&O investigation.

During the F&O investigation, dissolved phase constituents of petroleum were detected in groundwater samples collected from monitoring wells near tanks OT-7 through OT-9. Monitoring wells were not installed in the vicinity of tank OT-4; however, petroleum hydrocarbons were identified in soil samples collected at the top of the water table in nearby borings. These findings, combined with the later discovery of fuel oil in the tank farm storm drainage system, prompted the Department of the Navy to also evaluate the condition of the three No. 6 fuel oil tanks (OT-1, OT-2 and OT-3).

No. 6 Oil Tank Investigation: An investigation of No. 6 fuel oil tanks OT-1 through OT-3 was conducted by ERM in the Spring of 1991. The investigation revealed the presence of soil and groundwater contamination near tank OT-2. Dissolved phase constituents of petroleum were detected in groundwater samples collected from monitoring wells on the north, west, and southwest side of the tank. Soil and groundwater contamination near tanks OT-1 and OT-3 was not detected.

NEX Service Station Investigations: In the Fall of 1991, ERM conducted an investigation to determine the extent of groundwater contamination downgradient of the NEX gasoline service station, located opposite the UST farm on Tang Avenue. An earlier investigation of the NEX facility was conducted by O'Brien and Gere (OBG) in 1989/1990 which revealed the presence of two on-site plumes of separate phase product. The report from this study indicates that the product appeared to closely resemble weathered gasoline. Product was also discovered in a catch basin located downgradient of the pump islands where a loss of gasoline due to a faulty crash valve and pipe leak reportedly occurred. The problem was corrected and a baffle and weir were installed in a downstream catch basin to collect gasoline product. The NEX station storm drains connect into drainage system beneath the UST farm. The entire system discharges southwest of tank OT-9 into Goss Cove.

The ERM investigation focused on determining the extent of dissolved phase plume migration from the NEX facility to the UST farm. Five monitoring wells (ERM-15 through ERM-19) were installed south of Tang Avenue. Two additional wells (ERM-13 and ERM-14) were installed west of the former NEX fuel dispensing area. (Gas chromatograph (GC) fingerprint analysis of a select number of groundwater samples collected during the investigation confirmed the migration of gasoline contaminants to the UST farm. Gasoline contamination was most apparent in monitoring wells located north and west of tank OT-2.

1.8 REGULATORY REQUIREMENTS

The UST farm is located in a region where the groundwater is classified as GB/GA. This classification has an immediate goal of maintaining the water in a Class B condition and a long term goal of restoration to drinking water quality. The CTDEP evaluates such sites on a case-by-case basis and has no stated clean-up goals. However, clean-up criteria of 10 times the drinking water guidelines have typically been used in the past. CTDEP drinking water guidelines are provided in Table 1.

SECTION 2 SCOPE OF WORK

To fully characterize environmental conditions in the UST Farm, ERM is proposing an integrated field program consisting of characterization of tank residues, soil gas surveys, soil borings and monitoring well installation, investigation of underground pipelines, catch basin sediment sampling, and surface water sampling. Rationale and methodology for each individual task are provided in the following sections.

ERM will complete the following major tasks during the Remedial Investigation (RI) to address all areas of concern:

Task 1 Project Mobilization
Task 2 Underground Storage Tank Sampling
Task 3 Soil Gas Survey
Task 4 Pipeline Sediment Sampling
Task 5 Soil, Surface Water and Ground Water Sampling and Analysis
Task 6 Report Preparation
Task 7 Project Management And Meetings

The scope has been developed based upon a review of readily available information provided to ERM by the SUBASE, a kickoff meeting between Mr. William Mansfield, Environmental Division, Department of Engineering and Public Works, SUBASE, New London, and ERM discussions with NAVFAC's Mr. Brian Helland (August 20, 1992), and a series of recommendations outlined by Ms. Carol A. Keating of the United States Environmental Protection Agency (EPA) in a March 5, 1992 letter to the Department of the Navy (Appendix A). The tasks are sequenced to allow an initial data-gathering effort to provide screening information needed to finalize Task 5, the soil boring and monitoring well installation sub-tasks. The initial tasks 1 through 4 will also be used to finalize the list of analytical parameters for the soil, sediment and groundwater sampling program, which is described in Task 5 of this plan.

As per the EPA request, ERM will investigate the fuel lines that run from Building No. 332 to the tank farm for evidence of leakage. In addition, the contents of each of the eight remaining USTs will be sampled and analyzed according to EPA recommended parameters.

This scope does not include a detailed evaluation of remedial alternatives, engineering design, or preparation of remedial work plans. Remedial investigations are typically conducted in phases and it is possible that

additional measures may be required to fully characterize the horizontal and vertical extent of contamination. Following characterization of the physical and chemical characteristics of the site, ERM will provide preliminary recommendations regarding potential remedial actions.

2.1 *TASK 1 - PROJECT MOBILIZATION*

This task will include a kick-off meeting with SUBASE representatives to review scheduled field activities and literature search to review any additional data currently unavailable to ERM that would be useful in finalizing the scope of this investigation. Mr. Mansfield had earlier indicated to ERM that there may be buried pipelines in addition to the stormwater discharge and product transfer lines in the study area that would also need to be addressed.

The existing fuel lines that extend from the pier to the UST farm are scheduled to be tested by a contractor of the Department of the Navy during late June or early July 1992. ERM will await the results of this test prior to initiating investigative activities. Results of hydrostatic testing may alter the investigative approach proposed below. Fuel line testing will be managed by ERM, if the current effort by the SUBASE is not implemented in its entirety.

2.2 *TASK 2 - UNDERGROUND STORAGE TANK SAMPLING*

In accordance with the terms outlined by EPA's letter of March 5, 1992 (Appendix A) to the Department of the Navy, ERM will sample the contents of the eight existing USTs. Samples of sludge or liquid from each tank will be collected using a scoop, clam shell sampler, or like device, and analyzed for the presence of hazardous materials on the EPA Target Compound List/Target Analyte List (TCL/TAL), as instructed in the above-mentioned letter. A detailed description of sampling procedures and tank contents will be provided in the RI Report.

A finding of one or more TCL/TAL analytes in any of these samples may expand the analytical requirements for the remainder of the project.

2.3 *TASK 3 - SOIL GAS SURVEY*

The purpose of conducting a soil gas survey is to define the horizontal extent of petroleum contamination in the subsurface in a cost-effective manner. By locating areas where petroleum vapors are present in soils above the water table, a plume of petroleum (dissolved or separate phase)

can be rapidly delineated without installing a high density network of groundwater monitoring wells. Results of the survey will be used to select optimal well locations for long-term assessment of groundwater quality.

ERM proposes to conduct a soil gas survey along the new and old diesel underground pipelines from Building No. 332 to tanks OT-4 to OT-9. The No. 6 oil underground pipelines to tanks OT-1 to OT-3 are installed in lined trenches, which would prevent or minimize any potential soil and ground water impact from leaks. The old and new diesel lines are not, however, installed in lined trenches. Any leaks from these lines could have impacted directly the subsurface. It is estimated that there are more than 7,000 feet of diesel underground pipelines between Building No. 332 and the six diesel tanks. Identifying areas of subsurface contamination along those 7,000 feet of lines with soil borings, test pits or monitoring wells would be a very lengthy and costly process. A soil gas survey would be a more efficient initial screening technique to identify areas along the lines which may have been subject to leaks. Diesel fuel has a low proportion of volatile organic constituents, but sufficient enough so that residual diesel fuel in the subsurface can be detected by soil gas survey. Soil gas samples will be collected at intervals of approximately 100 feet along the underground diesel lines in an effort to identify potential points of leakage. An estimated 70 to 80 soil gas points will be initially required.

Soil gas samples will be collected for analysis from a 5/8" diameter stainless steel vapor probe driven to a depth of approximately two feet below the ground surface. This depth has been selected to ensure that the soil gas probe does not enter the capillary fringe or water table. As indicated in Section 1.3, the water table was encountered at a depth of approximately 3 feet near the northern boundary of the site.

Soil gas probes will be driven to the required depth using a rotary hammer. Once the soil gas probe is properly seated, the annular space at the ground surface will be tightly sealed using an impermeable material to prevent the flow of ambient air into the borehole.

Soil gas will be drawn from the borehole for a period of 2 minutes using a portable vacuum pump. Air will be suctioned from the soil gas probe, through a 75-millimeter glass sample collection tube and into the vacuum pump. The glass tube is connected to the probe and pump using disposable Teflon® tubing and stainless steel fittings. Each tube is equipped with 2 access ports which are opened and closed using Teflon® valves. During the purging process, both valves are left open allowing air to move freely from the intake (perforated) portion of the soil gas probe to the vacuum pump. After the 2-minute purging period has expired, the

exit valve of glass tube is closed isolating the pump from the remainder of the system. The intake valve is then left open for an additional 2 minutes as a soil gas sample collects in the glass tube. In the final step, the intake valve is closed and the tube containing the sample is disconnected from the system.

A soil gas sample is extracted from the collection tube using a syringe and injected into a gas chromatograph for analysis. The CG will provide a qualitative analysis of soil gas to identify and delineate plumes of petroleum. Analytes of particular interest would be benzene, toluene, ethylbenzene, total xylenes, and naphthalene. A complete list of aromatic and chlorinated hydrocarbons can also be detected with the CG. Through interpretation of gas sample chromatographs, a distinction between various petroleum products (No. 6 fuel oil, diesel, and gasoline) that may exist in the subsurface can be made.

The analyses will be performed on site using the ERM-FAST system in order to provide real time analytical data. The daily results of the survey will allow flexibility in this task and allow the field team to focus on individually identified areas of concern.

The findings from Task 2 will be used to finalize the soil and groundwater sampling tasks to follow.

2.4 *TASK 4 - PIPELINE SEDIMENT SAMPLING*

ERM proposes to collect samples from all tank farm catch basins which are located at the outlet of individual sections of drainage pipe. As shown on Figure 2, vitrified tile drainage pipes are present around five USTs (OT-1 through OT-5 and OT-6). If a release of fuel had occurred at one of the tanks listed above, petroleum would likely have entered the drainage pipe and discharged to a nearby catch basin.

Collection and analysis of sediment from each catch basin will be conducted to provide an indication of a previous release of petroleum. Sediment analytical data from the entire tank farm may aid in isolating potential source areas. Sediment samples will be analyzed according to EPA Methods 8020 + MTBE for benzene, toluene, ethylbenzene and zylene, 418.1 for Total Petroleum Hydrocarbons (TPH), and 8270 for Semivolatile Organic Compounds (SVOC).

2.5 TASK 5 - SOIL, SURFACE WATER, AND GROUND WATER SAMPLING AND ANALYSIS

At the conclusion of the initial phase of activities, ERM will meet with NAVFAC to discuss findings and additional tasks. ERM will have identified areas of concern and will have designed additional subsurface investigation tasks to characterize the nature and extent of the suspected problems. Areas along the diesel fuel lines and the storm water drains will most likely require additional investigation, because there are no previous investigations or reported areas of line failure which would help to target the initial investigation. A combination of soil borings, monitoring wells and Hydropunch II in situ groundwater sampling will be utilized to complete the site characterization efforts.

A dual approach is proposed to investigate soil and ground water contamination at the tank farm. The combined results of these two approaches will facilitate the characterization of the extent of the subsurface contamination by petroleum products at the fuel tank farm.

The first approach is to focus the characterization in the vicinity of the tanks based on known problems from previous investigations, if available. Section 2.5.1 describes the proposed sampling program. The second approach addresses potential problems on a more site-wide basis at areas where large data gaps exist between tanks or areas downgradient of the tanks; at areas along the perimeter surrounding the tanks, addressing both upgradient conditions and conditions along underground drain or fuel lines; and at areas within the tank farm along storm water catch basins and drainage lines which may contribute to ground water contamination. Section 2.5.2 describes the site-wide program.

The proposed sampling locations are shown on Figure 2 and the proposed sampling program is summarized on Table 2. The summary descriptions of the individual sampling protocols are presented in the sections below.

2.5.1 *Proposed Sampling in the Vicinity of the Tanks*

Tanks OT-1 and OT-3

These two No. 6 fuel oil tanks were investigated by ERM in 1991. No soil or ground water contamination was detected in the 8 wells installed (Four around each tank) except trace level of VOC (25 ppb of total BTEX) in well ERM-11 located on the north side of tank OT-3. These two tanks probably did not impact the subsurface. No new sampling locations are proposed around these two tanks. The 8 existing wells will be resampled as part of the site-wide ground water quality assessment (Section 2.5.2).

Tank OT-2

The area around No. 6 fuel oil tank is characterized by two distinct problems:

1. A plume of dissolved gasoline extends southward from the NEX station area to the north and west side of the tank.
2. Oil was found in the soil above the water table of Well ERM-7 located on the southwest side of the tank.

The plume of dissolved gasoline has been well defined by the existing monitoring well network; however, ERM proposes to collect a hydropunch ground water sample (H2-2) downgradient of Well ERM-19 (Figure 2) to identify the downgradient edge of the plume where the ground water is uncontaminated. Well ERM-19 had no BTEX detected, but low concentration of TPH (0.6 ppm) was detected in the ground water.

To determine the vertical and areal extent of oil contaminated soil on the southwestern side of Tank OT-2 and help better locate the source of the oil, ERM proposes to conduct a soil boring program initially entered on Well ERM-7. Four borings will be drilled and continuously sampled down to the water table and every 5 feet down to the level of the tank bottom around ERM-7 in a radial pattern, but not toward Tank OT-2.

The borings will be located at 10 to 15 feet from ERM-7. If during the field work, oily-stained soils are encountered, additional borings would be drilled 10 to 15 feet farther away from the subject boring(s) until visually clean soil is encountered (i.e., no oil observed, no odor, no PID readings). From each boring, a visually clean soil sample would be analyzed for TPH, BTEX, and SVOC to confirm that the soil is free of oil.

A hydropunch ground water sample (H2-1) is also proposed 30 to 50 feet downgradient of Well ERM 7 to assess if the oily soil found in the area of ERM-7 may impact ground water in a downgradient location.

The existing wells in the vicinity of Tank OT-2 will be resampled as part of a site-wide ground water quality assessment.

Tank OT-4

Four soil borings were drilled by F&O in 1989, around this diesel oil tank. No wells were installed. Up to 940 ppm of TPH (Fuel oil scan) were found in boring TB-4, located on the upgradient eastern side of Tank OT-4.

ERM proposes to drill and sample two soil borings in the vicinity of the previous boring TB-4 to delineate a potential soil impact. The borings will extend to the base of the tank. One hole will be converted into an upgradient monitoring well (ERM-23). To complete the ground water quality characterization in the vicinity of this tank, two wells (ERM-22 and ERM-24) are proposed on the downgradient western side of the tank. These three wells will allow one to verify the inferred westerly to southwesterly ground water flow direction. To complement the ground water quality data from these proposed wells, two hydropunch ground water samples are proposed in further upgradient and downgradient locations of the tanks (H4-1 and H4-2). Upgradient ground water sample H4-2 will also address potential ground water impacts related to spills or leaks at the northeast corner of the old and new diesel oil lines (Figure 2).

Tanks OT-5 and OT-6

The two former diesel oil tanks will be investigated in a similar manner to Tank OT-4, as described above. Because no subsurface sampling was conducted around these two tanks, an initial characterization will require four wells around each tank as opposed to the three proposed wells for Tank OT-4.

As shown on Figure 2, the four proposed wells around each tank have been located, assuming general westerly ground water flow around Tank OT-5 and a northwesterly flow around Tank OT-6. Proposed Well ERM-28 will be located' near the waste oil tank OT-10 where oil was discovered in the ground during the installation of that tank. If oil is encountered during the drilling of ERM-28 or at other locations around OT-5, additional soil borings will be drilled in an attempt to delineate the presence of oil in the subsurface. Selected oily soil samples would then also be tested for the presence of PCBs, as a PCB problem seems to be associated with that tank.

As with Tank OT-4, two complementary Hydropunch ground water samples are proposed upgradient and downgradient of the two tanks. The two downgradient Hydropunch locations (H5-1 and H6-1) will also be located in the area where the diesel oil lines from the tanks are connected to the main diesel lines.

Tank OT-7

Four wells were installed by F&O in 1989, around this diesel fuel tank. Dissolved fuel oil was detected in Well MW-1 on the north side of the tank. Ground water in these remaining wells are apparently uncontaminated. Ground water elevations in the vicinity of Tank OT-7

suggest a northeasterly ground water flow. To delineate the extent of ground water contamination on the north side of the tank, ERM proposes to collect three hydropunch ground water samples (H7-1 to H7-3) around the vicinity of Well MW-1 (Figure 2).

Tank OT-8

F&O installed four wells around this diesel fuel tank in 1989. A GC scan indicated dissolved fuel oil in two wells: 5 ppm in upgradient Well MW-6 and 52 ppm in Well MW-7 located on the south side. Ground water flows in a northwesterly direction around this tank. During the 1991 No. 6 fuel oil tanks investigation, ERM also measured ground water levels in the F&O wells installed around the diesel tanks in order to establish a more complete ground water contour map. More than 2 feet of floating oil was found in Well MW-7.

The floating product problem and associated ground water contamination in the vicinity of diesel Tank OT-8 needs to be delineated to determine the most effective method for recovering the floating product and determine the extent of the plume of the diesel oil dissolved constituents.

ERM proposes to drill four borings centered around Well MW-7 to determine the level of residual diesel oil in soils.

Four soil borings will be initially drilled within 10 to 15 feet around Well MW-7, with possibly one borehole between the tanks and the well and will extend down to the base of the tank. If oil-stained soils are found in the field, additional borings would be drilled and sampled 10 to 15 feet farther away from the borings that would exhibit evidence of oil until visually clean soil would be encountered (i.e., no oil observed, no odor, no PID readings above background). One soil sample per borehole (visually clean in the field) would be analyzed for TPH, BTEX, and SVOC, which are, like for gasoline, important constituents of diesel oil.

In the upgradient boring to the southeast and the downgradient boring to the northwest, two Hydropunch ground water samples (H8-3 and H8-2) will be collected to access the ground water contamination in the immediate vicinity of Well MW-7. To complete this assessment, two additional Hydropunch ground water samples are proposed in farther upgradient location (H8-3) and downgradient location (H8-1). Note that Sample H8-4 will also address ground water quality in an upgradient location of Well MW-6 and will also be located near the old diesel line.

The water samples from the wells and Hydropunch sampling points will be analyzed for BTEX, base neutrals and TPH.

Tank OT-9

Four wells were installed by F&O in 1989. Well MW-12 on the southwest side of this diesel fuel tank was found to be dry in 1989 and on three occasions in 1991 during the ERM investigation. The remaining three wells contained dissolved fuel oil from 4 to 14 ppm. Ground water flows to the northwest in the vicinity of the tank. To delineate the extent of ground water contamination around the tank, ERM proposes to collect five Hydropunch ground water samples in farther upgradient and downgradient locations as well as on the sides of the tank. The Hydropunch locations (H9-1 and H9-5) are shown on Figure 2. Ground water samples from the three wells and the five Hydropunch locations will be analyzed for BTEX, SVOC, and TPH.

To determine if residual diesel fuel may exist in the soil, ERM proposes to drill and sample two soil borings in the vicinity of Well MW-11 in which the highest concentration of dissolved fuel oil was detected (14 ppm).

2.5.2 *Proposed Sampling on a Site-Wide Basis*

Additional subsurface sampling is proposed on a more site-wide basis at areas not located in the immediate vicinity of the tanks. These additional sampling locations will assess potential contamination associated with the major storm water drain lines and diesel fuel lines and will help fill some of the major data gaps in areas between the tanks.

To address concerns with the storm water lines, ERM proposes to collect five Hydropunch ground water samples (H-1 to H-4 and H-6) complemented by three monitoring wells (ERM-20, ERM-21 and ERM-33). The locations of these sampling points, as shown of Figure 2, will also fill the major gaps between the tanks. The three wells proposed will be placed at locations where previous ground water contour maps suggested the presence of a trough, or depression on the water table, as a result of a probable induced drainage influence of the major storm water lines. These three wells, as permanent monitoring points, will help to better evaluate the ground water flow regime at the tank farm.

To address concerns with the diesel fuel lines, as well as characterize ground water quality in upgradient locations on the perimeter of the tank farm, six Hydropunch ground water samples are proposed.

As shown on Figure 2, the proposed locations include H-5 to the north between OT-3 and OT-4, H-7 to H-11 to the south along the diesel fuel lines near Crystal Lake Road. Sample H-9 will be located near the old diesel line and will help address a large gap between Tanks OT 7 and OT-8.

Ground water samples will be analyzed for BTEX, SVOC, and TPH.

2.5.3 *Soil Borings*

Soil borings will be drilled with a hollow stem auger rig. Continuous split-spoon samples will be collected from each boring and logged by the supervising of the ERM field geologist. The borings will be terminated at the water table, or extended to the base of the tanks, when the boring is located near a tank.

Each sample will be screened for the presence of volatile organic compounds (VOCs) using a Micro Tip II Photoionization Detector (PID). Selected soils will be collected for laboratory analyses according to EPA, as described in Section 6.3 of the work plan methods 8020, 8270, and 418.1. Additional parameters may be necessary depending upon site-specific locations and the findings from earlier tasks.

In selected borings, an in situ groundwater sample will also be collected to evaluate groundwater quality (see the following description). *In situ* groundwater sampling will be collected using a device known as the Hydropunch. Hydropunch sampling is described in Section 2.5.5.

2.5.4 *Monitoring Well Installation*

Monitoring wells will be installed to provide a long-term ground water monitoring and hydrogeologic measuring system. A typical well construction diagram is presented in Appendix B.

Fourteen monitoring wells will be installed using a hollow stem auger drilling rig. Continuous split spoon samples will be collected from each boring and logged by the supervising hydrogeologist from ERM. All split spoons will be screened for the presence of volatile organic compounds (VOCs) using a Micro Tip II Photoionization Detector (PID). Soil samples will be collected from immediately above the water table in each boring and submitted for laboratory analysis according to EPA methods 8020, 8270, and 418.1.

All monitoring wells will be constructed with a minimum of 10 feet of 2.0-inch, internal diameter (I.D.), 0.020-inch, machine slotted, polyvinyl chloride (PVC) well screen and flush -threaded PVC riser. The annular space will be gravel packed with graded silica sand to a depth of at least 1 foot above the top of the well screen followed by a minimum 1-foot-thick bentonite pellet seal. The remaining annular space will be filled with a bentonite - cement grout. Each well will be completed at the land surface with a 6- or 8-inch diameter utility-type, flush mounted steel protective

road box. The area around each well will be returned to its pre-existing condition after well installation has been completed.

The SUBASE Department of Public Works (DPW) will be contacted at least 10 days in advance of installation of monitoring wells. The DPW will be provided with documents indicating proposed well locations, well construction procedures and materials, and anticipated drilling schedule.

2.5.5 *In Situ Groundwater Sampling Procedures Using Hydropunch*

In situ groundwater sampling requires the use of a drilling rig to advance a soil boring and drive the Hydropunch to the required depth. For this task, soil borings will be advanced to the capillary fringe using 4-1/4-inch I.D. hollow stem augers. Continuous split spoon samples will be collected from each boring and logged by the supervising hydrogeologist from ERM. All split spoon samples will be field monitored for the presence of VOCs using a PID-like organic vapor meter (OVM). Geologic logs will be completed to provide documentation of materials encountered in the subsurface.

Once the soil boring is completed, the hydropunch will be assembled and attached to the drive rod using procedures specified by the manufacturer. The hydropunch will then be lowered to the bottom of the boring and driven approximately 3 feet into the water table. This depth has been selected since it will allow for the collection of both groundwater and petroleum samples, in the event that floating product is encountered. Liquid samples will be collected from the five foot screened portion of the hydropunch using a stainless steel bailer. A detailed description of the hydropunch is provided below and in Appendix E.

The hydropunch contains a stainless steel barrel assembly approximately 5 feet in length and 2.5 inches in diameter. Each assembly has a detachable penetrating cone and an inner sample collection chamber. The hydropunch is attached to drilling rods and pushed or driven to the desired sampling depth from the ground surface or from the bottom of a drilled borehole. The inner chamber is sealed while the punch is driven to the desired sampling depth. When the proper depth is reached, the drill rods and outer barrel are withdrawn from the bottom of the boring, allowing the outer barrel to detach from the penetrating cone. Groundwater will then flow into the inner collection chamber. The collection chamber is equipped with either a 1.2-liter sample container or a 5-foot, 1-inch diameter slotted polypropylene pipe similar to well screen. Where hydrocarbons are of concern, the use of screened pipe is recommended.

Groundwater is retrieved from the hydropunch using a thin bailer that is passed through the drilling rods from the ground surface and into the screen. After the sample collection process is complete, the hydropunch is pulled from the ground leaving behind the screen and penetrating cone.

Drilling equipment will be steam cleaned between borings. Potable water will be obtained from the SUBASE water supply for this purpose. A new screen and penetrating cone will be used at each sampling location.

2.5.6 *Monitoring Well Gauging and Sampling*

Monitoring well gauging and groundwater sampling will be performed upon completion of well installation activities. Wells will be gauged using a petroleum/water interface probe, or a clear bailer, for the detection of separate phase product. All monitoring wells which do not contain separate phase product will be sampled. Sections 6.4 and 6.5 describe sampling procedures for the collection of groundwater samples.

2.5.7 *Elevation Survey*

The top of PVC well casing and ground surface elevation for each new monitoring will be established relative to SUBASE Vertical Datum (SVD) by a Connecticut Certified Land Surveyor. The ground surface elevation at each punch sampling point will also be determined.

2.5.8 *Analytical Parameters*

All soil surface water and groundwater samples will be analyzed according to the following methods:

- Benzene, toluene, ethylbenzene and xylene (BTEX), including methyl test butylbenzene ether (MTBE) - EPA Method 8020.
- Total Petroleum Hydrocarbons (TPH) by IR - EPA Method 418.1.
- Semivolatile organic compounds (SVOCs), or Base/Neutral/Acids, EPA Method 8270.

ERM will collect and preserve all samples in accordance with CTDEP and EPA protocols. All samples will be submitted to Envirotest Laboratories, Inc. (State of Connecticut Certification No. PH-0554) in Newburgh, NY for analysis. Table 3 provides information on sample analyses, methods, containers, preservation requirements and holding times by sample matrix.

As indicated under Task 1, the EPA has recommended that the contents of all tanks be sampled and analyzed for the full list of TCL/TAL parameters to confirm or deny the presence of hazardous materials in the source areas. In the event that hazardous materials are identified in the contents of one or more tanks, ERM will evaluate the need for additional analyses at other sampling points. The list of analytical parameters for soil and groundwater will be modified, where necessary, to include compounds identified in tank sludges or liquids. The extended list of parameters will be incorporated into the analysis of samples collected near tanks where hazardous materials are identified during Task 1.

2.5.9 *In situ Permeability Tests*

Slug tests, or *in situ* permeability tests, will be conducted by ERM in selected monitoring wells to determine hydraulic conductivity of the aquifer where sources of groundwater contamination are identified. A determination of hydraulic conductivity is necessary in providing an estimate of groundwater and contaminant migration rates. These rates would be used for the design of groundwater recovery and treatment system should remedial action be required.

Slug tests will be conducted using the rising head method. This method is used when determining hydraulic conductivity in wells which the screened interval is not open over the entire thickness of the unconfined aquifer. The test is conducted by lowering a solid slug (constructed of Teflon®, PVC, or stainless steel) into the well and allowing the water level to equilibrate to static conditions. Once equilibrium conditions have been achieved, the test is initiated by quickly withdrawing the slug from the well. Removal of the slug rapidly displaces the column of water into the lower portion of the well, resulting in recharge from surrounding aquifer. The rate of recharge is recorded over time until the water level in the well has again achieved static conditions. These data will later be used in the calculation of hydraulic conductivity. For the tests proposed by ERM, changes in water level will be recorded automatically using a pressure transducer and data logger. By using automatic measuring equipment, changes in water level can be recorded at 1-second intervals to prevent a loss of important test data.

Slug test data will be analyzed using the Bouwer and Rice method to determine formation permeabilities at each well.

2.5.10 *Surface Water Sampling*

ERM proposes to collect surface water samples from the unnamed stream which enters the tank farm from the east. The stream flows beneath the tank farm via underground piping and discharges at the storm drainage outlet shown on Figure 2. Collection of surface water samples at the entrance and outlet of the underground piping will help determine whether petroleum is entering the stream from beneath the site. In addition, the samples may also help determine whether contaminated surface water is entering the tank farm from an unidentified upstream source. A review of aerial photographs indicated that the stream flows in close proximity to at least one former service station facility.

Surface water samples will be analyzed according to EPA Methods 8020 + MTBE, 418.1 and 8270.

2.6 *TASK 6 - REPORT PREPARATION*

ERM will prepare a draft and final report. The final report will consider and incorporate the Navy's comments on the draft and will be in a format that is acceptable for submittal to CTDEP. The report will be illustrated with clear, concise figures and maps, where appropriate. The report will include:

- Introduction;
- Background;
- Scope of Work;
- Data Interpretation;
- Boring and Well Logs;
- Ground Water Flow Maps;
- Site Map Showing All Sampling Locations;
- Contaminant Distribution Map;
- Tabulated Analytical Results;
- List of Applicable or Relevant and Appropriate Requirements (ARARs) Used in Evaluating the Data;
- Slug Test Data;
- Survey Data;
- Water Level Measurement Records;
- Soil Gas Survey Data;

- Chain-of-Custody Forms; and
- Laboratory Analysis and QA/QC Data;
- Conclusions and Recommendations.

2.7 *TASK 7 - PROJECT MANAGEMENT AND MEETINGS*

The purpose of this task is to ensure completion of the project on-time and on-budget, provide oversight of project personnel, and ensure regular interaction with Navy personnel. This task includes general communication and coordination, financial management, and personnel and project scheduling. In addition to an initial project planning meeting, the ERM project team will be available for public or private meetings to present and discuss results and recommendations.

SECTION 3 PROJECT PERSONNEL

ERM has assembled a project team comprised of personnel who have completed similar assignments on projects equivalent to the project outlined in the Scope of Work. ERM's project team offers the Navy several important benefits:

- The project team has conducted numerous Phase I remedial investigations related to gasoline releases in both unconsolidated and fractured bedrock terrain.
- The senior professionals assigned to the project have worked with the CTDEP and are familiar with the regulatory process in Connecticut.
- The key personnel assigned to the RI are familiar with the project site and were involved in the development of the Scope of Work.

The proposed project organization is illustrated in Figure 3. Mike Cody, Project Manager, will be responsible for project control, technical review, and client interaction. The work on-site will be directed by Noah Levine, Project Geologist.

The key project personnel selected for the project team based on their availability for the assignment, experience with petroleum site assessments, and managerial skills are presented below.

PERSON	FUNCTION
Jim Talbot, Ph.D.	Program Manager
Mike Cody, P.G.	Project Manager
Noah Levine	Project Geologist/On-Site Manager
Jim Testo	Corporate Health and Safety Officer
Noah Levine	Site Health and Safety Officer
David Blye	Chemistry QA Manager

SECTION 4 PROJECT SCHEDULE

ERM's proposed project schedule is shown in Figure 4. It is anticipated that the project will take approximately 24 weeks to complete, including Navy review and submission of final report.

SECTION 5 SITE-SPECIFIC HEALTH AND SAFETY PLAN

5.1 SITE NAME AND ADDRESS

Underground Storage Tank Farm
Naval Submarine Base
Groton, Connecticut

5.2 SITE PERSONNEL WITH ASSIGNED RESPONSIBILITIES

Program Manager	Jim Talbot
Project Manager	Mike Cody
Site Manager/Project Geologist	Noah Levine
Corporate Health & Safety Officer	Jim Testo
Site Health & Safety Officer	Noah Levine

5.3 SITE DESCRIPTION

The site is the Naval Submarine Base located in Groton, Connecticut.

5.4 PLANNED ACTIVITIES

Project activities include services necessary to complete an investigation of soil and groundwater in the underground storage tank farm.

5.5 POTENTIAL HAZARDS

Material Safety Data Sheets (MSDS) for suspected contaminants of concern are provided in Appendix D.

Chemical (Fuel Oil)

There is no specified acceptable exposure limit for fuel oils. Acceptable exposure limits for gasoline and its constituents have been used to provide the action level guidelines specified below. These guidelines can be applied to activities involving exposure to gasoline and/or fuel oil contamination.

Gasoline

Gasoline has a maximum acceptable exposure level or Threshold Limit Value (TLV) expressed as a Time Weighted Average (TWA) (8 hours per day) of 300 ppm and a Short Term Exposure Limit (STEL) of 500 ppm over a period of 15 minutes according to the American Conference of Governmental Industrial Hygienists. Benzene is found in gasoline in varying concentrations ranging from 1 to 10%. Other significant components of gasoline include toluene, xylene, and ethylbenzene. The permissible exposure limit (PEL) for benzene is 1 ppm due largely to the carcinogenic nature of the compound. A PEL of 100 ppm has been established for xylene, toluene, and ethylbenzene.

Benzene concentrations must be monitored within the workers' breathing space throughout intrusive activities involving contaminated or potentially contaminated media (soils, groundwater, etc.). Benzene monitoring will be conducted any time organic vapors reach or exceed 10 ppm in the breathing space as measured by an OVM. Benzene can be monitored using colorimetric indicator tubes (e.g., Draeger Pump Kit).

If OVM readings reach or exceed 10 ppm in the breathing space during excavations/drilling operations, benzene monitoring will be conducted at each 3-foot interval of excavation/boring advancement. If OVM readings reach or exceed 10 ppm in the breathing space during groundwater sampling activities, benzene monitoring will be conducted at least once during well purging and prior to sampling. Benzene monitoring will not be required once an excavation/borehole is completed and monitoring results indicate that no benzene is present within the detected airborne gas/vapor mixture.

If benzene is not found within the workers' breathing space, and VOC concentrations are between 0 and 100 ppm as measured with the OVM, Level D Personal Protective Equipment (PPE) will be worn. The 100 ppm action level has been set based on the PEL of toluene, xylene, and ethylbenzene. Level D is regular work clothing. Outer gloves and boots will also be worn since there is potential for direct contact with contaminated soils. If the VOC concentrations are 100 to 500 ppm, or benzene concentrations are greater than 1 ppm, Level C PPE (half face respirator with organic cartridges) will be worn. A full-face air purifying respirator will be required for VOC concentrations between 500 and 900 ppm or benzene concentrations greater than 10 ppm in the breathing space. If the VOC levels exceed 900 ppm or benzene concentrations

greater than 50 ppm in the breathing space, the area will be evacuated and the ERM Health and Safety Coordinator and appropriate SUBASE personnel will be contacted. If the VOC levels exceed 900 ppm or benzene exceeds 50 ppm in the breathing space, Level B (supplied air) PPE must be worn or the area must not be re-entered until the vapors dissipate.

Fuel oils/gasoline vapors are dangerous fire hazards when exposed to heat, flame or oxidizers. To fight fire, foam, CO_2, or dry chemicals will be used. When heated to decomposition gasoline emits an acrid smoke and irritating fumes. Gasoline has a flash point of -45°F.

The ERM Site Health and Safety Officer will continuously monitor the air with an explosimeter in addition to an OVM. If combustible gas levels exceed 20% LEL, the work area will be evacuated until it is positively ventilated. If the level is between 10 and 20% LEL, only intrinsically safe instruments should be used.

Physical (Utilities)

Planned activities require installation of soil borings and possible excavation. All utility companies and local authorities will be notified of planned excavation activities and all underground utilities will be appropriately marked.

5.6 *EMERGENCY CONTACTS AND DIRECTIONS TO NEAREST HOSPITAL*

Mike Cody - ERM Project Manager	(203) 929-8687
Police	911
Fire	911
Ambulance	911

A hospital is located on Tang Avenue at the southern end of the SUBASE. To get to the hospital from the tank farm head east on Tang Avenue approximately 0.4 miles. The hospital is located at the top of a small hill on the left hand side of Tang Avenue.

5.7 *DISPOSAL OF CONTAMINATED HEALTH AND SAFETY EQUIPMENT*

Contaminated health and safety equipment, including clothing and personal protective devices, will be disposed of in a 55-gallon drum, labelled and picked up by a certified hazardous waste disposal contractor, or delivered to the SUBASE HAZMAT facility on base.

5.8 *HEALTH AND SAFETY EQUIPMENT LIST*

The following equipment will provided on site during the field program:

Petroleum/Water Interface Probe - Marine Moisture Control
Tyvek coveralls - white
Respirator - full face
Respirator - half face
pH meter
OVM meter (OVM) Micro Tip II Photo
Photoionization detector (PID)
Water level indicator
Gloves - latex
Gloves - neoprene
Gloves - PVC
Filter cartridge - dust/mist
Filter cartridge - organic vapors
LEL/O_2 meter
Decontamination supplies
Draeger unit

SECTION 6 QUALITY ASSURANCE/QUALITY CONTROL PLAN

6.1 PURPOSE

The purpose of this Quality Assurance/Quality Control (QA/QC) Plan is to define standard operating procedures for the Groton, CT SUBASE Remedial Investigation of the Underground Tank Farm so that reliable data collection and analyses are ensured. the enclosed sampling program is based upon currently accepted EPA standards for assessing potential groundwater and soil contamination problems.

The following EPA Guidance Documents were consulted:

1. Superfund Data Quality Objectives for Remedial Response Activities; Development Process, March 1987 (VOL I).
2. RCRA Groundwater Monitoring Technical Enforcement Guidance Document, September, 1986.

The tasks defined under this QA/QC Plan include:

- soil gas survey;
- drilling activities;
- pre-monitoring well sampling activities;
- monitoring well evacuation and sampling activities;
- QA/QC samples; and,
- other QA/QC protocols.

The primary use for the data collected during this investigation will be site characterization. The existing concentrations of any contaminants found will be compared to selected Federal and State ARARs.

6.2 DRILLING ACTIVITIES

Drilling, Well Construction, and Protective Well Cover

ERM will supervise the installation of all borings and monitoring wells and ensure that all wells are constructed in compliance with EPA protocols. Borings will generally consist of 6- to 8-inch holes in which 1-3/8-inch inner diameter split-spoon samples will be taken. Wells will be drilled primarily using the auger and/or drive and wash techniques. The

drilling contractor, at his option and with ERM approval, may employ drilling methods involving uncased wall-supported holes or use of hollow stem augers or any combination of these methods, provided he can also perform split tube sampling as required. No unsupported hole methods will be used. Field boring logs will be used to record all data obtained during drilling.

During well installation, detailed logs will be maintained by an experienced geologist and documented in the field log books. The borehold and all soil samples will be field screened with an OVM PID, or like instrument, to measure for VOCs. Representative samples from all split spoons will be placed in capped and aluminum foil sealed jars for head space analyses at a later date. See the following section for details on split spoon sampling and headspace analysis.

Upon completion of each boring to the desired depth, a 4-inch I.D. PVC well will be installed in the boring. The well will include 10 to 15 feet of machine slotted PVC well screen conforming to ASTM Schedule 40; the remainder will be solid PVC riser. All PVC and slotted casing will be clean, flush joint and have threaded couplings. For all water table monitoring wells, the well screens will be placed so that the screens intersect the water table, thereby allowing for seasonal fluctuations in the water table and for detection of any floating contaminants.

A clean, silica sand pack will be set around the screen extending from the base of the boring (at least 1 foot below the well screen) to a level 2 feet above the top of the screened section. A minimum 3-foot-thick layer of bentonite pellets will then be set. A bentonite/portland cement grout will be placed above the bentonite well seal up to a level 2 feet below ground level. The wells will be finished with a 1-foot concrete surface seal and a flush mounted road box such that the concrete collar extends from the road box in all directions. The cap of the road box will be secured by bolts and the PVC casing with a locking cap. All well construction details will be included in the drilling logs (an example is attached in Appendix B).

Wells will be developed by pumping until the discharge is free of sediment, and the pH and conductivity measurements of the discharge have stabilized. Soils from drilling, and water removed from the wells will be collected into 55-gallon drums for interim storage pending analytical results. Based on those results, the materials will be disposed of properly by the SUBASE.

Topographic Survey

The well locations, ground elevations, and top of PVC casing will be surveyed by a registered surveying firm and located on a base map. Horizontal well locations will be surveyed to an accuracy of ±1.0 foot and referenced to the Connecticut State Grid. Top of casing elevations will be surveyed to an accuracy of ±0.01 foot and referenced to SVD. The well number will be affixed to the road box and will be visible with the cap on.

The top of casing measuring point will be clearly marked on the inner lip of the road box. Ground-water level data from all wells will be used to prepare water table contour maps and determine hydraulic gradients and ground-water flow directions.

Split-Spoon Sampling and Decontamination

Split spoon soil samples will be collected according to ASTM techniques using a 1-3/8-inch I.D. split tube sampler. Two-foot-long samples will be collected continuously to the water table and then at lithology changes, 5-foot intervals, or at the discretion of the on-site geologist. The sampler will be driven into the ground using a 140-pound hammer dropped from a height of 30 inches until either 24 inches have been penetrated or 100 blows have been applied in any 6- inch section. The number of blow counts for each 6-inch interval will be recorded on the well log.

Upon extraction of the sampler from the borehole, the sampler will be opened and screened with a PID. A visual inspection and classification will be performed on the sample and a geological description will be recorded on the well log. The length of the recovered sample will be recorded before portions of the soil are used to fill laboratory containers for later analysis. Soil samples for TPH analysis will be collected in wide mouth pre-cleaned glass jars supplied by the laboratory, cooled to 4 degrees Celsius, and analyzed within 28 days. The portion of the sample which is not held for laboratory analysis will be collected in glass jars, covered with aluminum foil, and capped. The jar will be labeled with the:

- job number;
- boring number;
- sampling interval;
- blow counts; and
- date.

The jar sample will be allowed to equilibrate to room temperature for at least 10 minutes. The sample will be vigorously shaken for 15 seconds both at the beginning and end of the headspace development period and then opened while leaving the foil cover on top. The end of a PID meter will be forced through the foil to collect a headspace reading. Both stable and peak readings will be recorded.

The sample from each boring which is closest to the water table will be sent to the laboratory for analysis of TPH by infrared (IR) method (EPA Method 5520).

The split spoon samplers will be decontaminated using a system consisting of:

- an initial Alconox and water wash;
- a secondary fresh water wash;
- a tertiary methanol rinse; and
- a final distilled water rinse.

6.3 *PRE-MONITORING WELL SAMPLING ACTIVITIES*

Well Maintenance Check

Prior to each sampling event, ERM personnel will routinely inspect the condition of each monitoring well to ensure that the protection casing, lock cover and surface seal remain intact. Observations regarding these inspections will be recorded in the site field data book. This record will include well number, condition, date, and time of observation.

Health and Safety Air Monitoring

An air purifying respirator will be required if benzene concentrations reach or exceed 1 ppm in the breathing space. A full-face air purifying respirator will be required if benzene concentrations reach or exceed 10 ppm in the breathing space. Air supplied respirators will be required if benzene concentrations exceed 50 ppm in the worker breathing zone. A PID probe will be held over the well casing after the initial uncapping to make this determination. All readings, including non-detectable, will be recorded in the field data book. All field activities will be conducted under appropriate OSHA regulations and guidelines and the site-specific health and safety plan (see Section 5.0).

Water Level Measurements

ERM will gauge each well with an optical interface probe to determine depth to water in each well and the presence of floating chemicals. The measuring device will be lowered into the well until water has been reached. The probe will be raised and then lowered a second time to check the accuracy of the first measurement. The cable will be held against the side of the inner protective well casing at the designated measuring point, and the depth measurement recorded to the nearest 0.01 feet. Any water level corrections due to floating product will be made.

The measuring device will then be raised out of the well and decontaminated by rinsing first with distilled water, then with methanol, and again with distilled water.

Water levels will be measured from the top of the PVC casing at the designated measuring point and recorded on a Monitoring Well Data Sheet, along with the date and time of reading and observers initials.

6.4 *MONITORING WELL EVACUATION AND SAMPLING*

Each well will be purged by pumping until at least three well volumes have been removed or the well is pumped dry. All purging, field monitoring and sampling activities will be conducted so that the entire purging area is protected from contamination. All necessary purging and sampling apparatus will be contained so that the potential for cross contamination of samples is mitigated. Field personnel will wear dedicated latex or vinyl gloves when handling sampling equipment and sample containers.

During the purging activity, the specific electrical conductance will be measured using a YSI Field Meter and analysis of pH and temperature will also be conducted using an Orion Research Model SA 250 Meter, or like instrument. Instrument probes will be decontaminated by wiping and rinsing with methanol followed by tap and distilled water rinses. Liquids generated by sampling and decontamination will be held in properly labelled drums and disposed of by a licensed, certified hazardous water contractor. The pH instrumentation will be standardized before and after the sampling event and will be decontaminated as above. After the well has been purged, samples will be collected by lowering a bailer until it intersects the water table. The sample will then be raised and a volume of water will be dispensed into two 40-milliliter (ml) glass vials and two or three 1-liter amber glass bottles. The 40-ml vials will be slowly filled with a minimum of turbulence and allowed to overflow before capping to eliminate all headspace and reduce potential loss of VOCs. One

groundwater sample from each well will be sent to the laboratory for analysis of VOCs by EPA Method 8020 and TPH by IR, Method 418.1, and SVOC by Method 8270.

The well will not be purged and no water samples will be collected if petroleum product (non-aqueous phase liquid) is detected at the water table. The thickness of petroleum in the well will be recorded in the site field data book.

Once each well has been sampled, all well-specific materials will be disposed of in a large plastic garbage bag and placed in the field vehicle for disposal at the end of the day. These include the plastic protective flooring, nylon line, gloves, spent respirator cartridges if applicable, rags and other refuse materials.

6.5 *QUALITY ASSURANCE/QUALITY CONTROL SAMPLES*

Duplicates

One duplicate ground-water sample will be collected and analyzed for every 20 ground water samples collected. This "blind" duplicate sample will be labeled so that the laboratory will not be able to distinguish between it and any other sample. The duplicate will be split evenly from the same bailer load to the extent possible. Duplicate sample data will be recorded in the field data book along with all of the other samples.

In addition, the laboratory will split one soil sample collected for TPH and perform one duplicate analysis.

Equipment Blank

One equipment blank will be collected each day for each type of sampling device employed. For the proposed project, this sample will consist of deionized water that has contacted all instrument probes which have been previously decontaminated as described above. This water will then be placed into a set of laboratory prepared sample containers and analyzed for VOCs, TPH, and SVOC. The equipment blank will serve as a check on both the effectiveness of the instrument probe decontamination procedures and on potential contaminants associated with the sample containers. It should be noted that an additional "field blank" is not required because dedicated sampling equipment will be used.

Trip Blank

One trip blank will be analyzed at a frequency of one per day, per shipment of VOCs. The trip blank will be prepared by the laboratory, and it will accompany the field personnel from the office, to the site, to each sampling point and then back to the laboratory. The trip blank will be analyzed for VOCs to determine whether contamination may have occurred during sample handling, transportation, storage and/or shipping procedures.

6.6 *OTHER QA/QC PROTOCOLS*

Sample Handling

All samples will be sealed, stored in an ice-filled cooler, and sent by overnight delivery to the laboratory.

The contract laboratory will provide all bottles in a "ready to use" state. All necessary preservatives will be added to sample containers by the laboratory prior to shipment to ERM.

Sample Labels

Sample labels will be placed on all containers in the field and will include the following information:

- date and time of collection;
- sample location;
- sample number;
- analysis requested;
- name of sampler;
- preservative; and,
- number of containers (i.e., 1 of 2).

Documentation

The field log book and field data sheets used during each sampling procedure will include the following information:

- sampling location;
- air monitoring readings;
- monitoring well maintenance information;
- total well depth;

- pH and conductivity readings;
- depth to water;
- well volume calculation;
- well evacuation procedure;
- sample identification (location, number);
- date and time;
- preservative; and,
- general field information.

Chain of Custody

A chain-of-custody form (attached in Appendix C) will be completed at the time of sample collection. The chain-of-custody form will be included with samples during shipment and signed by the contract laboratory upon receipt. Chain-of-custody forms will include the following information:

- sample number;
- sample identification;
- date and time of collection;
- sample matrix (groundwater, soil, sludge, etc.);
- sample location;
- number of containers;
- analytical parameters;
- dates of possession; and,
- signature of all individuals involved in the possession of samples.

Analytical Parameters

Maximum permissible holding times and sample preservation techniques for each analytical parameter are summarized in Table 2 and provided in the laboratory QA/QC manual.

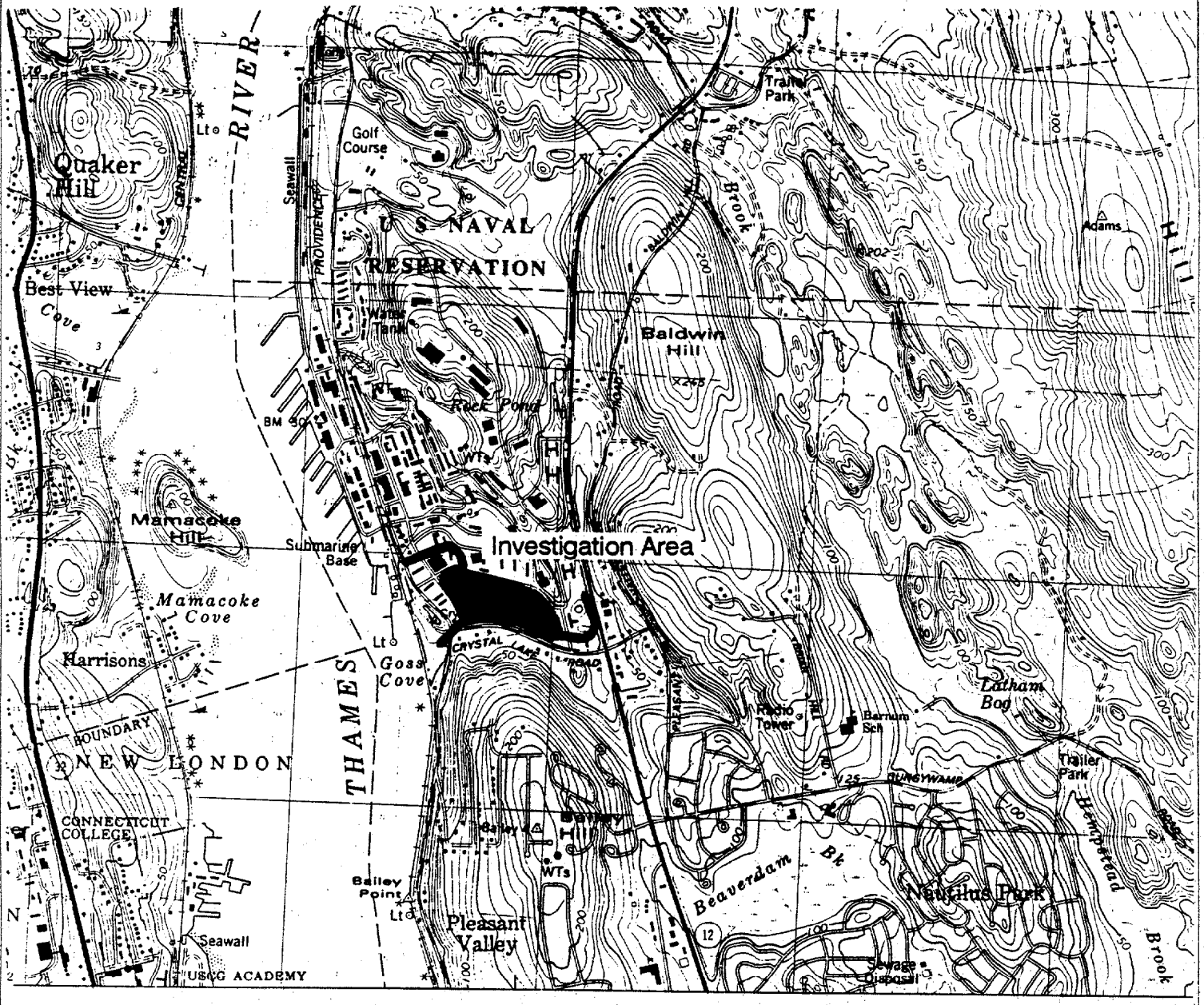
Data Validation

Data validation will be conducted by an ERM chemist experienced in analytical data review. Data will be evaluated with regard to holding times, required detection limits, precision, accuracy, reproducibility, comparability, and completeness.

QA/QC Personnel

ERM Program Manager	Jim Talbot
ERM Project Manager	Mike Cody
ERM QA/QC Manager	Ron Landon
Laboratory Project Manager*	Doug Tawse
ERM Data Validation Manager	David Blye

* Envirotest Laboratories, Inc.
315 Fulleston Avenue
Newburgh, NY 12550



SCALE 1:24 000

1 0 1 MILE

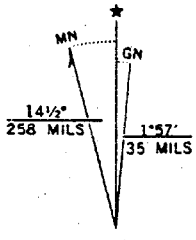
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

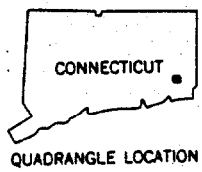
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UNCASVILLE, CONN.
41072-D1-TF-024

1984



UTM GRID AND 1984 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



QUADRANGLE LOCATION

Source: USGS Quadrangle Topo Map, Uncasville, CT, 1984.

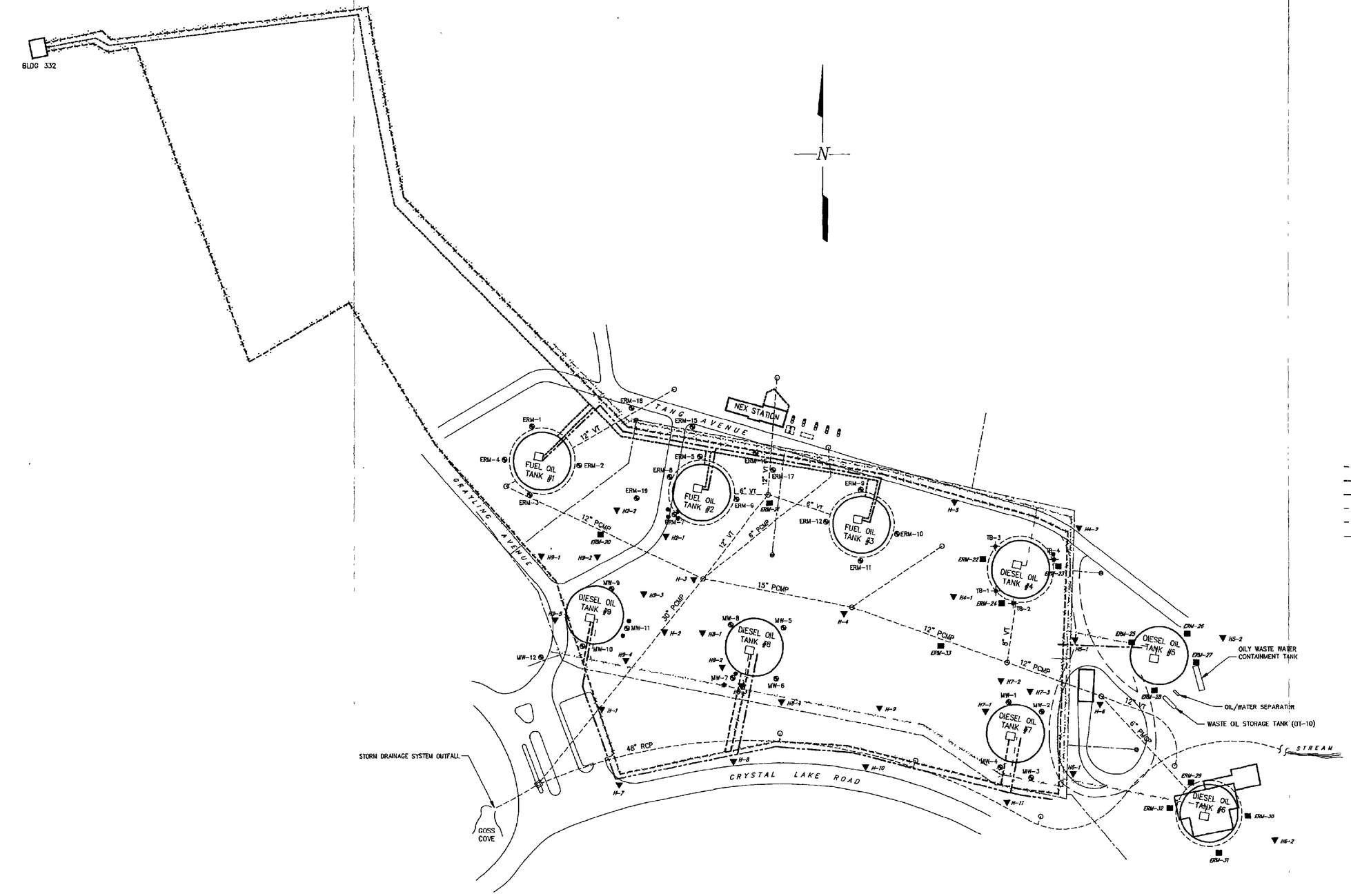
PC3: C:\123R23\SUBASE\TANKFARM\FIG-1.WK1

Title

SITE LOCATION
U.S. Submarine Base
Groton, Connecticut

Prepared for
Northern Division 24 State Area

Prepared by	Scale	Project No.
ERM–Northeast	As noted	450.011
Environmental Resources Management	Date	Figure
375 Bridgeport Ave. Shelton, CT 06484	06/22/92	1



LEGEND

- ERM-12 ⊕ EXISTING MONITORING WELL LOCATION AND DESIGNATION
- TB-1 ✦ EXISTING TEST BORING LOCATION AND DESIGNATION
- *ERM-31 ■ PROPOSED MONITORING WELL LOCATION AND DESIGNATION*
- *H6-2 ▼ PROPOSED HYDROPUNCH LOCATION AND DESIGNATION*
- *● PROPOSED SOIL BORING*
- *PROPOSED SOIL GAS SURVEY AREA (ALONG DIESEL LINES)*
- ○ STORM SEWER CATCH BASIN
- ● HYDRANT
- NEW DIESEL OIL PIPE LINE
- NEW FUEL OIL PIPE LINE
- NEW OILY WASTE WATER PIPE LINE
- STORM DRAIN PIPE LINE
- DIESEL OIL PIPE LINE (1946)
- SALT WATER PIPE LINE
- PCMP PERFORATED CORRUGATED PIPE
- VT VITRIFIED TILE
- RCP REINFORCED CONCRETE PIPE

0 50 100 150 200 300 400

Scale in Feet

NOTE:

UNDERGROUND PIPE LINE CONFIGURATIONS WERE INTERPRETED FROM SUBASE ENGINEERING PLANS DUE TO LACK OF UPDATED CONSTRUCTION DIAGRAMS THE CONFIGURATION SHOWN MAY VARY SLIGHTLY FROM ACTUAL PIPE LINE LOCATIONS

SITE PLAN AND PROPOSED SAMPLING LOCATIONS FUEL FARM UNDERGROUND STORAGE TANK NAVAL SUBMARINE BASE, GROTON CT

PREPARED FOR: ERM–PMC	DATE: 8/28/92	FIGURE: 2
PREPARED BY: **ERM-Northeast** Environmental Resources Management 375 Bridgeport Ave Shelton CT 06484	DWG NO.: 450–011A	PROJECT NO.: 450.011
	SCALE: AS SHOWN	SIZE: D

06581301X

Figure 3
Project Staffing
SUBASE, New London, Connecticut

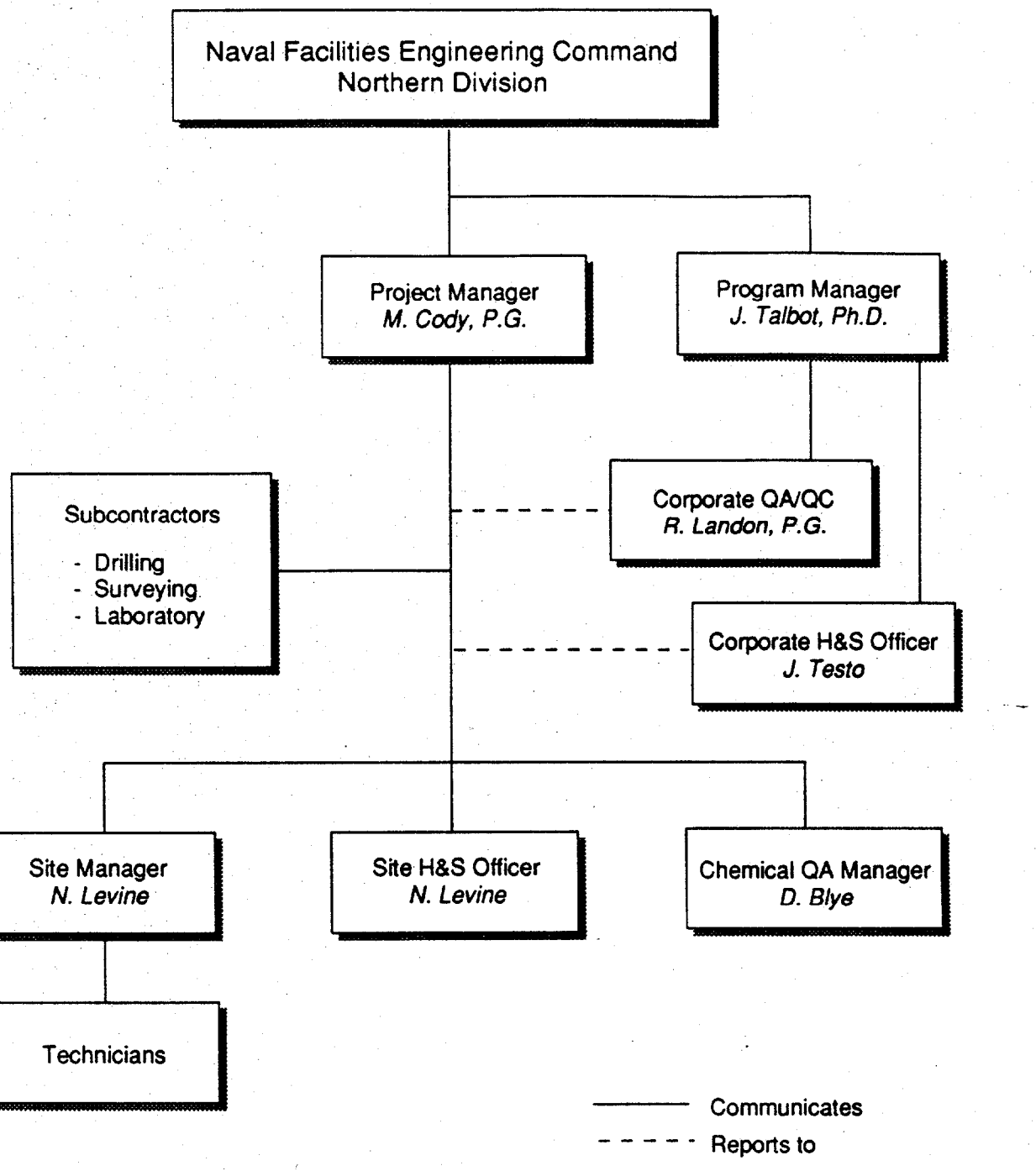
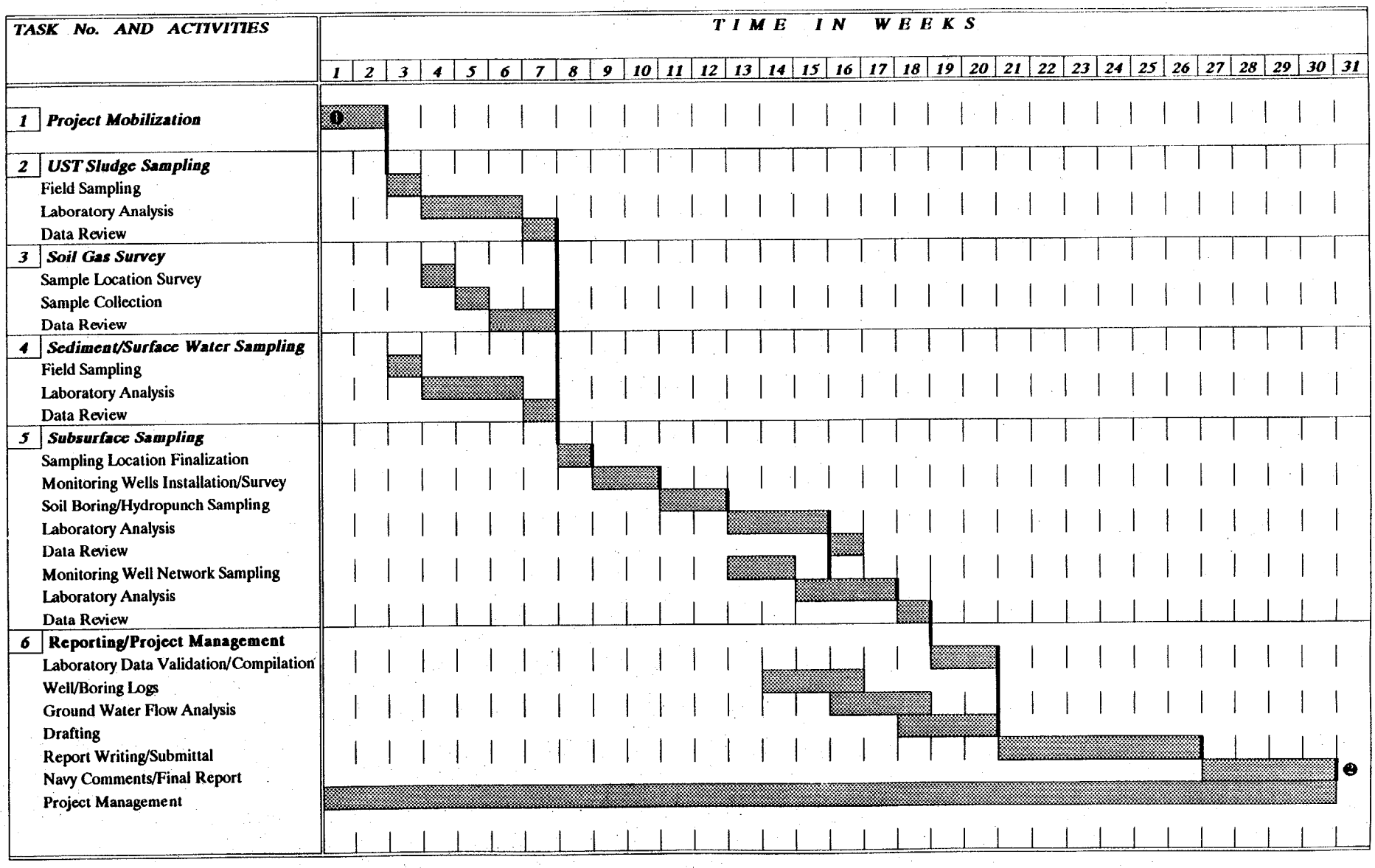


FIGURE 4
PROJECT SCHEDULE
Fuel Farm UST, Naval Submarine Base, Groton, CT



❶ – Project scheduling meeting between ERM and SUBASE personnel.

❷ – Final report.

PC3 C:\123R23\SUBASE\TANKFARM\SCHEDULE.WK1

Compiled By: NL, Chkd by: PD

Table 1
CTDEP Drinking Water Guidelines

Organic Compounds	Action Level (µg/l)
Acrylonitrile	35
Benzene	1*
Carbon tetrachloride	5**
1,2-Dibromoethane (EDB)	0.1
Para-Dichlorobenzene	75**
1,2-Dichloroethane (EDC)	1*
1,2-Dichloroethylene	7**
1,2-Dichloropropane	5
1,3-Dichloropropene	10
Dieldrin	0.01
1,4-Dioxane	20
Ethylbenzene	700
Ethylene glycol	100
Isopropyl alcohol	1,000
Manganese	5,000
Methylene chloride	25
Methylethyl ketone	1,000
Methyl tert-butyl ether (MTBE)	100
Polychlorinated biphenyls (PCB)	1
Tetrachloroethylene (PCE)	5
Toluene	1,000
Total xylenes	N/A
1,1,1-Trichloroethane	200**
Trichloroethylene	5**
Vinyl chloride	2**

Inorganic Compounds	Action Level (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.010
Chromium	0.05
Cyanide	0.2
Lead	0.05
Mercury	0.002
Nitrite nitrogen	1.0
Selenium	0.01

* The Environmental Protection Agency (EPA) has promulgated Maximum Contaminant Levels (MCLs) for these compounds at 5 µ/l, with a health-based MCL Goal of zero. Connecticut is currently using the indicated action levels for these compounds.

** EPA has established MCLs for these compounds at the concentrations indicated.

TABLE 2
SUMMARY OF REMEDIAL INVESTIGATION WORK PLAN
Fuel Farm UST, Naval Submarine Base, Groton, CT

AREAS	EXISTING MONITORING WELLS	PROPOSED SAMPLING: SOIL BORING	HYDROPUNCH II (*In situ* ground water sampling)	MONITORING WELL	No. of Soil Samples	No. of Tank Bottom Samples	No. of Ground Water Samples	PROPOSED ANALYSIS: BTEX + MTBE (Method 8020)	BTEX (Method 8020)	BASE NEUTRALS (Method 8270)	TPH (Method 418.1)	TCL/TAL* VOC/BN Pest/PCBs Metals Cyanide	REMARKS
TANK OT-1													
(No. 6 Fuel Oil)	ERM-1						1		1	1	1		No soil and ground water contamination was detected in these four wells. The wells around this tank will be resampled as part of the site-wide ground water assessment.
	ERM-2						1		1	1	1		
	ERM-3						1		1	1	1		
	ERM-4						1		1	1	1		
						1						1	
TANK OT-2													
(No. 6 Fuel Oil)	ERM-5						1	1		1	1		The investigation is designed to delineate the oil presence in the soil around well ERM-7, evaluate the potential downgradient impact on ground water and confirm the downgradient extent of the dissolved gasoline plume originating from the NEX station to the north.
	ERM-6						1	1		1	1		
	ERM-7						1	1		1	1		
	ERM-8						1	1		1	1		
	ERM-19						1	1		1	1		
		6			6					6	6		
			H2-1				1	1		1	1		
			H2-2				1	1		1	1		
						1						1	
TANK OT-3													
(No. 6 Fuel Oil)	ERM-10						1		1	1	1		No soil and ground water contamination was detected in these four wells, except trace level in ERM-11. The wells around this tank will be resampled as part of the site-wide ground water assessment.
	ERM-11						1		1	1	1		
	ERM-12						1		1	1	1		
	ERM-13						1		1	1	1		
						1						1	
TANK OT-4													
(Diesel oil)		3			3				3	3	3		No wells exist around this tank. Three wells are proposed complemented by two Hydropunch samples in farther downgradient and upgradient locations. A potential soil problem *(Previous boring TB-4)* on the east side will be investigated *(One boring and one well)*. H4-2 will also help address concern near the diesel underground lines.
				ERM-22	1		1		1	1	1		
				ERM-23	1		1		1	1	1		
				ERM-24	1		1		1	1	1		
			H4-1				1		1	1	1		
			H4-2				1		1	1	1		
						1						1	
TANK OT-5													
(Diesel oil & waste oil)				ERM-25	1		1		1	1	1		No subsurface data exist around that tank. Four wells around the tank are proposed complemented by two Hydropunch samples in farther up and downgradient locations. Oily soil may be encountered near well ERM-28. Soil delineation would then be required and analysis for PCB *(On-going PCB issue at this tank)*.
				ERM-26	1		1		1	1	1		
				ERM-27	1		1		1	1	1		
				ERM-28	1		1		1	1	1	1	
			H5-1				1		1	1	1	1	
			H5-2				1		1	1	1	1	
						1						1	

TABLE 2
SUMMARY OF REMEDIAL INVESTIGATION WORK PLAN
Fuel Farm UST, Naval Submarine Base, Groton, CT

AREAS	PROPOSED SAMPLING						PROPOSED ANALYSIS					REMARKS
EXISTING MONITO-RING WELLS	SOIL BORING	HYDRO-PUNCH II (*In situ* ground water sampling)	MONITO-RING WELL	No. of Soil Samples	No. of Tank Bottom Samples	No. of Ground Water Samples	BTEX + MTBE (*Method 8020*)	BTEX (*Method 8020*)	BASE NEU-TRALS (*Method 8270*)	TPH (*Method 418.1*)	TCL/TAL* VOC/BN Pest/PCBs *Metals* *Cyanide*	
TANK OT-6 (Diesel oil, tank was demolished in mid 70's)			ERM-29	1		1		1	1	1		No subsurface data exist around that tank. Four wells around the tank are proposed complemented by two Hydropunch samples in farther up and downgradient locations. H6-2 will also address concern near the diesel lines connection.
			ERM-30	1		1		1	1	1		
			ERM-31	1		1		1	1	1		
			ERM-32	1		1		1	1	1		
		H6-1				1		1	1	1		
		H6-2				1		1	1	1		
TANK OT-7 (Diesel oil) MW-1						1		1	1	1		Four wells exist. Dissolved fuel oil found in MW-1. Delineation is proposed with 3 Hydropunch samples around MW-1 and resampling of the existing wells.
MW-2						1		1	1	1		
MW-3						1		1	1	1		
MW-4						1		1	1	1		
		H7-1				1		1	1	1		
		H7-2				1		1	1	1		
		H7-3				1		1	1	1		
					1						1	
TANK OT-8 (Diesel oil) MW-5						1		1	1	1		Floating oil (*2.10 ft*) was present in MW-7. Delineation of oil in the subsurface is proposed with 4 soil borings, 2 Hydropunch samples, complemented by two farther up and downgradient Hydropunch samples.
MW-6						1		1	1	1		
MW-7						1		1	1	1		
MW-8						1		1	1	1		
	4			4				4	4	4		
		H8-1				1		1	1	1		
		H8-2		1		1		1	1	1		
		H8-3		1		1		1	1	1		
		H8-4				1		1	1	1		
					1						1	
TANK OT-9 (Diesel oil) MW-9						1		1	1	1		Elevated disoolved fuel oil was detected in the three existing wells. Delineation of the ground water contamination is proposed with 5 Hydropunch samples around the tank. Also two soil borings will be drilled near MW-11, well with the highest fuel oil concentration in groun water, to assess the potential presence of residual oil in the soil.
MW-10						1		1	1	1		
MW-11						1		1	1	1		
(MW-12 was dry)												
	4			4				4	4	4		
		H9-1				1		1	1	1		
		H9-2				1		1	1	1		
		H9-3				1		1	1	1		
		H9-4				1		1	1	1		
		H9-5				1		1	1	1		
					1						1	

TABLE 2
SUMMARY OF REMEDIAL INVESTIGATION WORK PLAN
Fuel Farm UST, Naval Submarine Base, Groton, CT

AREAS	PROPOSED SAMPLING						PROPOSED ANALYSIS					REMARKS
EXISTING MONITORING WELLS	SOIL BORING	HYDRO-PUNCH II (*In situ* ground water sampling)	MONITORING WELL	No. of Soil Samples	No. of Tank Bottom Samples	No. of Ground Water Samples	BTEX + MTBE (*Method 8020*)	BTEX (*Method 8020*)	BASE NEUTRALS (*Method 8270*)	TPH (*Method 418.1*)	TCL/TAL* VOC/BN Pest/PCBs *Metals* *Cyanide*	
Central Tank Farm Area, Along Major Storm Water Lines		H-1				1		1	1	1		The 3 proposed wells and 5 Hydropunch samples will help evaluate the potential effect of major storm water lines on the ground water flow and quality, as well as addressing data gaps between tank areas.
		H-2				1		1	1	1		
		H-3				1		1	1	1		
		H-4				1		1	1	1		
		H-6				1		1	1	1		
			ERM-20			1		1	1	1		
			ERM-21			1		1	1	1		
			ERM-33			1		1	1	1		
Perimeter of the Tank Farm Area		H-5				1		1	1	1		These 6 proposed Hydropunch samples will address upgradient ground water quality to the northeast and south of the tank farm, as well as addressing conditions near the old and recent diesel oil lines.
		H-7				1		1	1	1		
		H-8				1		1	1	1		
		H-9				1		1	1	1		
		H-10				1		1	1	1		
		H-11				1		1	1	1		
Catch Basin Sampling						10	10		10	10		
Surface Water Sampling						4	4		4	4		
SUBTOTALS ⇨	*17*	*31*	*14*	*30*	*8*	*83*	*21*	*73*	*100*	*100*	*11*	
Quality Assurance/ Quality Control												
	Field Blanks						2	13	14	14	1	
	Blind Duplicates						2	4	5	5	1	
	Trip Blanks						2	13	14	14	1	
TOTALS ⇨	*17*	*31*	*14*	*30*	*8*	*83*	*27*	*103*	*133*	*133*	*14*	

Note: * See Table 3 for analytical methods

450.011 By: PD, Chkd by: MC

PC3 c:\l23r23\subase\tankfarm\plan-sum.wk1

TABLE 3

GROUND WATER, SURFACE WATER, SOIL, AND SLUDGE ANALYTICAL SUMMARY

Fuel Farm UST, Naval Submarine Base, Groton, CT

MATRIX	*ANALYSES*	*USEPA Analytical Method*	*CONTAINER*	*PRESERVATION*	*SAMPLING HOLDING TIME*
Ground Water	TPH	418.1	1 liter amber glass	H_2SO_4, Cool 4°C	14 days /40 days [1]
	BTEX & MTBE	8020	2 x 40 ml glass vials	HCl, Cool 4°C no headspace	14 days
	Base/Neutrals	8270	1 liter amber glass	Organic wash, Cool 4°C	7 days /40 days
Surface Water	TPH	418.1	1 liter amber glass	H_2SO_4, Cool 4°C	14 days /40 days [1]
	BTEX & MTBE	8020	2 x 40 ml glass vials	HCl, Cool 4°C no headspace	14 days
	Base/Neutrals	8270	1 liter amber glass	Organic wash, Cool 4°C	7 days /40 days
Soil	TPH	418.1	250 ml amber glass	Cool 4°C	7 days /40 days
	BTEX & MTBE	8020	60 ml (2 oz) Qorpak(R)	Cool 4°C	14 days
	Base/Neutrals	8270	250 mg amber glass	Cool 4°C	7 days /40 days
Sludge	TCL Volatiles	8240 + 10 Tics	60 ml (2 oz) Qorpak(R)	Cool 4°C	10 days
	TCL Semi volatiles	8270 + 10 Tics	1 liter amber glass	Cool 4°C	7 days /40 days
	TCL Pesticides / PCB's	8080	included above	Cool 4°C	14 days/40 days
	23 TAL Metals	SW 846	included above	Cool 4°C	6 months[2]
	TAL Cyanide	9010	included above	Cool 4°C	14 days

[1] 14 day/40 days – 14 day extraction period holding time and 40 days holding time after extraction.

[2] Except for Mercury which is 28 days.

Appendix A
5 March 1992 Letter from USEPA to Department of the Navy

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JF. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

March 5, 1992

RECEIVED
MAR 11 1992
Waste Management Bureau
Site Remediation Division

Ms. Adrianne P. Townsel
U.S. Department of the Navy
Northern Division - NAVFAC
U.S. Naval Base - Building 77L
Philadelphia, PA 19112

Dear Ms. Townsel:

This letter is in regard to the September 1989 report entitled "Hydrogeologic Investigation: Underground Storage Tanks OT-4, OT-7, OT-8, OT-9 and 54-H - U.S. Naval Submarine Base - New London, Groton, Connecticut" prepared by Fuss & O'Neill, Inc. EPA has reviewed this document and offers the following comments and recommendations with regard to additional investigatory work to be performed at the aforementioned underground storage tank areas.

Based on data provided in the above referenced report, there is evidence of releases of petroleum from these underground storage tanks (USTs) and/or their associated piping to ground water and soil. There is currently not enough information, however, to adequately characterize the nature and extent of releases related to these USTs. Although the data presented indicate that releases of No. 2 fuel oil and fuel-related BTEX compounds to soil and ground water have occurred, it is uncertain whether the presumed "waste oils" stored in the tanks designated as reclamation tanks also contain other hazardous constituents.

Given that the USTs in the upper base and lower base areas are potential sources of subsurface and ground water contamination, the UST's contents must be physically evaluated and sampled. Although results of the hydrogeologic investigation revealed the presence of No. 2 fuel oil and BTEX compounds in soil and ground water, there were no analyses conducted for other VOCs, semivolatiles, metals, pesticides or PCBs. Therefore, samples should be collected from each UST and analyzed for the full list of TCL/TAL parameters to confirm or deny the presence of hazardous constituents in the source areas. In addition, full TCL/TAL analyses should be conducted on soils and ground water near tanks OT-4, OT-5 and 54-H to define the extent of contamination in these areas. In addition, the "underground lines which run from the piers to the storage tank areas" in the upper base and piping between tanks in the lower base should be thoroughly investigated as potential sources of contamination.

Should you have any questions or comments with regard to the above, please do not hesitate to call me at (617) 573-5764. I look forward to hearing from you soon.

Sincerely,

Carol A. Keating

Carol A. Keating
Remedial Project Manager
Federal Facilities Superfund Section

cc: Paul Jameson, CTDEP
William Mansfield, SUBASE New London
Matthew Hoagland, USEPA
Dale Weiss, Alliance Technologies Corporation

Appendix B
Sample Drilling Log

ERM – Northeast
375 Bridgeport Avenue, Shelton CT 06484 (203) 929–8687

LOG OF BORING: *EXAMPLE*

Project name & location		*Project number*	*Date & time started*	*Date & time completed*	
Drilling company		*Driller*	*Ground elevation & datum*	*Completion depth*	*Rock depth*
Drilling equipment		*Method*	*Number of soil and/or rock samples:*	*disturbed* / *undisturbed* / *rock core*	
Bit(s)		*Core barrel(s)*	*Ground Water level(s) information, in ft below ground*	*Time* / *Depth* / *Notes*	
Casing	*Casing hammer*	*Drop*			
Soil sampling tool(s)	*Sampler hammer*	*Drop*	*Drilling angle & direction*	*Geologist(s)*	

SOIL DESCRIPTION	GRA-PHIC LOG	DEPTH (ft below grade)	SOIL SAMPLES: No.	Recovery (ft)	Blow per 6 in.	Time collected	MICROTIP READINGS (ppm): Soil Sample	Ambient air	Time of measur.	REMARKS
		0								
		1								
		2								
		3								
		4								
		5								
		6								
		7								
		8								
		9								
		10								
		11								
		12								
		13								
		14								
		15								
		16								
		17								
		18								
		19								
		20								
		21								
		22								
		23								
		24								
		25								

Percentage of Sample
0% < trace < 10%
10%< little <20%
20%< some <35%
35%< and < 50%

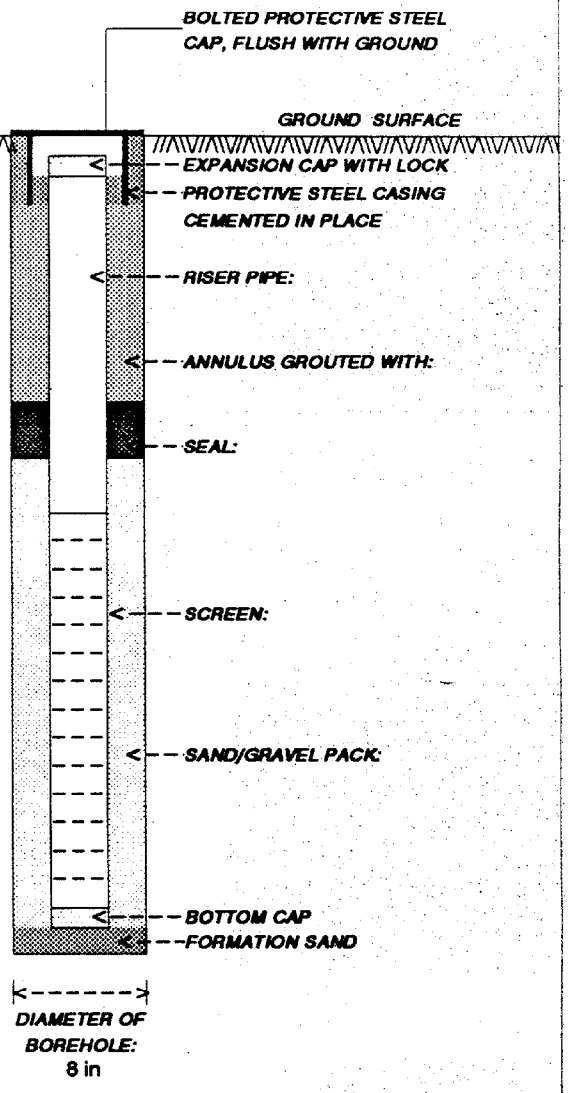
vf – very fine	c – coarse
f – fine	vc – very coarse
m – medium	

ERM–Northeast
375 Bridgeport Avenue, Shelton, CT 06484 (203) 929–8687

CONSTRUCTION OF MONITORING WELL: *EXAMPLE*

Project name & location	*Project No.*	*Ground water (Ft below top PVC)*			*Elevation datum*
		Date	*Time*	*Water level*	
Drilling company					*Ground elevation* Ft
Surveyor					*Top of protective steel casing elevation* Ft
Date and time of completion	*Geologist/Engineer*				*Top of riser PVC pipe elevation* Ft

GENERALIZED SOIL DESCRIPTION	ELEVATIONS (ft above Mean Sea Level)	DEPTHS (ft below ground, not to scale)	CONSTRUCTION DETAILS
		0	



REMARKS (Installation, development) :

Appendix C
Sample Chain of Custody

ERM-Northeast

375 Bridgeport Avenue, Shelton, CT 06484 • (203) 929-8687

Chain of Custody

Project Name / No. _____

Project Coordinator / Contact _____

Sampler(s) _____

Bottles Supplied By _____

Sheet No. _____

Type and No. of Containers

Date	Time	Comp.	Grab	Sample Identification	Soil	Water	Total No. of Containers									Analysis Requested

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time	Reason for Transfer

Copies: Sampler - White; Laboratory - Yellow

CHAIN OF CUSTODY RECORD

EnviroTest Laboratories Inc.
315 Fullerton Avenue
Newburgh, NY 12550
(914) 562-0890

Company Name, Location	Project Name/P.O. Number.	Project Site Location	Project Coordinator/Contact

SAMPLING DATE	TIME AM PM	COMP	GRAB	SAMPLE I D No.	SAMPLE BOTTLES: Total Number of Containers	40ml Glass HCL	Liter Amber Sulfuric Acid	Liter Amber Organic Washed	Liter Plastic Nitric Acid	Liter Plastic Sodium Hydroxide	Liter Plastic	Liter Plastic Sulfuric Acid	250ml Plastic	125ml Plastic Sterile	250 ml Amber.	2 oz. Cplpar.	ANALYSIS

Relinquished by EnviroTest Laboratories	Custody Shipping Number	Date / Time	Received by	Date / Time
Print _____ Signature _____			Print _____ Signature _____	

Relinquished by	Date / Time	Received by	Date / Time
Print _____ Signature _____			

Relinquished by	Date / Time	Received by ETL	Date / Time
Print _____ Signature _____			

REMARKS

Appendix D
Material Safety Data Sheets

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 467

AUTOMOTIVE GASOLINE, LEAD-FREE

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: AUTOMOTIVE GASOLINE, LEAD-FREE
DESCRIPTION: A volatile blend of hydrocarbons for automotive fuel
OTHER DESIGNATIONS: Petrol, CAS #008 006 619, ASTM D439
MANUFACTURER: Available from several suppliers.

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Gasoline A hydrocarbon blend that can include normal and branched chain alkanes, cycloalkanes, alkenes, aromatics and other additives.** (Lead max 0.013 g/L, phosphorus max 0.0013 g/L, sulfur max 0.10 wt%. May contain benzene, <5%; see ASTM D3606). *ACGIH 1981 TLV (Intended Changes List). See also Am. Ind. Hyg. A. 39 110-117 (1978) **The composition of fuel is varied with altitude and seasonal requirements for a locality. The blend must meet antiknock requirements. (Antiknock Index min 85, ASTM D439.)	100	8-hr TWA 300 ppm or 900 mg/m³* Man Eye: 500 ppm/1H Moderate irritation Inhalation: TCLo 900 ppm/1H TFX:CNS

SECTION III. PHYSICAL DATA

Distillation at 1 atm, Initial, deg C >39
50% distilled - 77-121
End point ---- <240
Vapor density (Air=1) ---------- 3.0-4.0
Solubility in water ---------- Insoluble

Specific gravity, 60/60 F - 0.72-0.76
Melting point, deg C ------ -90.5-95.4
Evaporation rate -------- N/A

Appearance and Odor: A clear, mobile liquid with a characteristic odor which can be recognized at about 10 ppm in air. (Gasoline may be colored with dye.)

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by volume	LOWER	UPPER
-45 F	536-853 F		1.4	7.6

Extinguishing Media: Dry chemical, carbon dioxide, alcohol foam. Use of water may be ineffective to extinguish fire, but use water spray for cooling fire-exposed drums and tanks to prevent pressure rupture. It is a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow along surfaces, reach distant ignition sources and flash back. Can react violently with oxidizing agents.
Firefighters should wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
This is an OSHA Class IA flammable liquid. A mixture of gasoline vapors and air can be explosive. It is incompatible with oxidizing agents.
Thermal-oxidative degradation can yield carbon monoxide and partially oxidized hydrocarbons.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 300 ppm (See Sect. II)

Inhalation causes intense burning of the mucous membranes, throat and respiratory tract; overexposure to vapors can lead to bronchopneumonia. Inhalation of high conc. can cause fatal pulmonary edema. Repeated or prolonged skin exposure causes dermatitis. Can cause blistering of skin due to its defatting properties. Exposure to eyes can cause hyperemia of the conjunctiva.

Ingestion or excessive vapors can cause inebriation, drowsiness, blurred vision, vertigo, confusion, vomiting and cyanosis (2000 ppm produces mild anesthesia in 30 min, higher conc. are intoxicating in less time.) Aspiration after ingestion causes bronchitis, pneumonia, or edema which can be fatal.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids.

Skin Contact: Remove contaminated clothing. Wash affected area with soap and water.

Inhalation: Remove to fresh air. Restore breathing and administer oxygen if needed.

Ingestion: Do not induce vomiting. Aspiration hazard. Contact physician.

Seek prompt medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition. Provide adequate ventilation. Clean-up personnel require protection against liquid contact and vapor inhalation. If a leak or spill has not ignited, use water spray to disperse vapors and to protect men attempting to stop the leakage. Contain spill. Do not allow to enter sewer or surface water. Add absorbent solid to small spills or residues and pick up for disposal.

DISPOSAL: Burn scrap material in an approved incinerator. Burn contaminated liquid by spraying into an incinerator. Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Use general and local exhaust ventilation (explosion-proof) to keep vapors below the TLV requirements in the workplace. Respirators should be available for nonroutine or emergency use above the TLV.

Avoid eye contact by use of chemical safety goggles and/or full faceshield where splashing is possible. Wear protective clothing appropriate for the work situation to minimize skin contact such as rubber gloves and boots. Clothing to be changed daily and laundered.

Eyewash fountains, showers and washing facilities should be readily accessible

Provide suitable training to those handling and working with this material.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from sources of heat, ignition and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IA liquid.

Outdoor or detached storage preferred. No smoking in areas of use. Prevent static electric sparks and use explosion-proof electrical services. (Must meet code.)

Avoid skin and eye contact. Avoid inhalation of vapors. Wear clean work clothing daily.

Indoor use of this material requires exhaust ventilation to remove vapors.

ICC Flammable Liquid, Red Label. LABEL: Flammable Liquid DOT I.D. No. UN 1203.

DOT Classification: FLAMMABLE LIQUID

DATA SOURCE(S) CODE: 2,4-9,34,37

APPROVALS: MIS CRD J.M. Kuiken

Industrial Hygiene and Safety 10-27-81

MEDICAL REVIEW: 4 November 1981

MATERIAL SAFETY DATA SHEET

Unocal Corporation
1201 West 5th Street, P.O. Box 7600
Los Angeles, California 90051

MANUFACTURER

UNOCAL CHEMICALS DIVISION - PETROCHEM. GROUP
UNION OIL COMPANY OF CALIFORNIA
1345 NORTH MEACHAM ROAD
SCHAUMBURG, ILLINOIS 60196

CONTACT FOR FURTHER INFORMATION:
YOUR LOCAL SALES OFFICE (LAST PAGE)

Transportation Emergencies:
CHEMTREC
(800) 424-9300 Cont. U.S.
(202) 483-7616 (Collect)
from Alaska & Hawaii
Health Emergencies:
Call LOS ANGELES POISON
INFORMATION CENTER (24 hrs)
1-(800)-356-3129

PRODUCT IDENTIFICATION

PRODUCT NAME: METHANOL

SYNONYMS:
AMSCO SOLV 5030
CARBINOL
COLONIAL SPIRIT
COLUMBIAN SPIRIT
METHYL ALCOHOL
METHYL HYDROXIDE
MONOHYDROXYMETHANE
PCN UCD 15030
PCN UCD 5030
PROXYLIC SPIRIT
UCD 810
WOOD ALCOHOL
WOOD NAPHTHA
WOOD SPIRIT

GENERIC NAME: VOLATILE SOLVENT

CHEMICAL FAMILY: OXYGENATED HYDROCARBON

DOT PROPER SHIPPING NAME: METHYL ALCOHOL

ID NUMBER: UN1230

DOT HAZARD CLASSIFICATION: FLAMMABLE LIQUID

SECTION I - COMPONENTS	PERCENT	EXPOSURE LIMIT	UNITS	AGENCY	TYPE
HAZARDOUS COMPONENTS					
METHANOL CAS #: 67-56-1		200.000	ppm	ACGIH	TWA-SKIN
		250.000	ppm	ACGIH	STEL-SKIN
		200.000	ppm	MSHA	TWA
		200.000	ppm	OSHA	TWA-SKIN
		250.000	ppm	OSHA	STEL-SKIN
		1000.000	ppm	CAL OSHA	CEIL
		600.000	ppm	CAL OSHA	EXCUR
		200.000	ppm	CAL OSHA	TWA-SKIN

SECTION I - COMPONENTS	PERCENT	EXPOSURE LIMIT	UNITS	AGENCY	TYPE

OTHER COMPONENTS

--NONE--

THIS PRODUCT CONTAINS THE FOLLOWING CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA 313 AND 40 CFR 372:	CAS NUMBER	WEIGHT %
METHANOL	67-56-1	99-100

SECTION II - EMERGENCY AND FIRST AID PROCEDURES

EMERGENCY
Have physician call LOS ANGELES POISON INFORMATION CENTER (24 hrs) (800) 356-3129

EYE CONTACT:

IF IRRITATION OR REDNESS DEVELOPS, MOVE VICTIM AWAY FROM EXPOSURE AND INTO FRESH AIR. FLUSH EYES WITH CLEAN WATER. IF SYMPTOMS PERSIST, SEEK MEDICAL ATTENTION.

SKIN CONTACT:

REMOVE CONTAMINATED SHOES AND CLOTHING AND CLEANSE AFFECTED AREA(S) THOROUGHLY BY WASHING WITH MILD SOAP AND WATER. IF IRRITATION OR REDNESS DEVELOPS AND PERSISTS, SEEK MEDICAL ATTENTION.

INHALATION (BREATHING):

IF RESPIRATORY SYMPTOMS DEVELOP, MOVE VICTIM AWAY FROM SOURCE OF EXPOSURE AND INTO FRESH AIR. IF SYMPTOMS PERSIST, SEEK MEDICAL ATTENTION. IF VICTIM IS NOT BREATHING, IMMEDIATELY BEGIN ARTIFICIAL RESPIRATION. IF BREATHING DIFFICULTIES DEVELOP, OXYGEN SHOULD BE ADMINISTERED BY QUALIFIED PERSONNEL. SEEK IMMEDIATE MEDICAL ATTENTION.

INGESTION (SWALLOWING):

IF SWALLOWED, SEEK EMERGENCY MEDICAL ATTENTION. IF VICTIM IS DROWSY OR UNCONSCIOUS, PLACE ON THE LEFT SIDE WITH THE HEAD DOWN AND DO NOT GIVE ANYTHING BY MOUTH. IF VICTIM IS CONSCIOUS AND ALERT, VOMITING SHOULD BE INDUCED PREFERABLY WITH SYRUP OF IPECAC UNDER DIRECTION FROM A PHYSICIAN OR POISON CENTER. IF SYRUP OF IPECAC IS NOT AVAILABLE, VOMITING CAN BE INDUCED BY GENTLY PLACING TWO FINGERS IN THE BACK OF THE THROAT. IF POSSIBLE, DO NOT LEAVE VICTIM UNATTENDED.

COMMENTS:

NOTE TO PHYSICIANS: THIS PRODUCT CONTAINS METHANOL. METHANOL IS METABOLIZED TO FORMALDEHYDE AND FORMIC ACID. THIS IN TURN MAY CAUSE METABOLIC ACIDOSIS, VISUAL DISTURBANCES AND BLINDNESS. BECAUSE METABOLISM MUST OCCUR BEFORE THE TOXIC EFFECTS, THE ONSET OF TOXIC SYMPTOMS MAY BE DELAYED FROM 6 TO 30 HOURS FOLLOWING INGESTION. ETHANOL COMPETES FOR THE SAME METABOLIC PATHWAY AND HAS BEEN USED AS AN ANTIDOTE. METHANOL IS EFFECTIVELY REMOVED BY HEMODIALYSIS.

SECTION III - HEALTH HAZARDS/ROUTES OF ENTRY

EYE CONTACT:

THIS MATERIAL MAY CAUSE MILD EYE IRRITATION. DIRECT CONTACT WITH THE LIQUID OR EXPOSURE TO VAPORS OR MISTS MAY CAUSE STINGING, TEARING AND REDNESS.

SKIN CONTACT:

THIS MATERIAL MAY CAUSE MILD SKIN IRRITATION. PROLONGED OR REPEATED CONTACT MAY CAUSE REDNESS, BURNING, AND DRYING AND CRACKING OF THE SKIN. CONTACT MAY RESULT IN SKIN ABSORPTION BUT SYMPTOMS OF TOXICITY ARE NOT ANTICIPATED BY THIS ROUTE ALONE UNDER NORMAL CONDITIONS OF USE. PERSONS WITH PRE-EXISTING SKIN DISORDERS MAY BE MORE SUSCEPTIBLE TO THE EFFECTS OF THIS MATERIAL.

SECTION III - HEALTH HAZARDS/ROUTES OF ENTRY

INHALATION (BREATHING):

WHILE THIS MATERIAL HAS A LOW DEGREE OF TOXICITY, BREATHING HIGH CONCENTRATIONS OF VAPORS OR MISTS MAY CAUSE IRRITATION OF THE NOSE AND THROAT AND SIGNS OF NERVOUS SYSTEM DEPRESSION (E.G., HEADACHE, DROWSINESS, DIZZINESS, LOSS OF COORDINATION, AND FATIGUE). RESPIRATORY SYMPTOMS ASSOCIATED WITH PRE-EXISTING LUNG DISORDERS (E.G., ASTHMA-LIKE CONDITIONS) MAY BE AGGRAVATED BY EXPOSURE TO THIS MATERIAL.

INGESTION (SWALLOWING):

THIS MATERIAL IS TOXIC AND MAY BE HARMFUL IF SWALLOWED. EFFECTS OF OVEREXPOSURE MAY INCLUDE IRRITATION OF THE DIGESTIVE TRACT, SIGNS OF NERVOUS SYSTEM DEPRESSION (E.G., HEADACHE, DROWSINESS, DIZZINESS, LOSS OF COORDINATION, AND FATIGUE), VISUAL DISTURBANCES (INCLUDING BLINDNESS), CONVULSIONS, COMA AND DEATH.

COMMENTS:

THIS MATERIAL HAS NOT BEEN IDENTIFIED AS A CARCINOGEN BY NTP, IARC OR OSHA. METHANOL CAUSES HARM TO THE FETUS IN LABORATORY ANIMAL STUDIES. THE RELEVANCE OF THESE FINDINGS TO HUMANS IS UNCERTAIN. REPORTS HAVE ASSOCIATED REPEATED AND PROLONGED OCCUPATIONAL OVEREXPOSURE TO SOLVENTS WITH PERMANENT BRAIN AND NERVOUS SYSTEM DAMAGE (SOMETIMES REFERRED TO AS SOLVENT OR PAINTERS' SYNDROME). INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING AND INHALING THIS PRODUCT MAY BE HARMFUL OR FATAL.

SECTION IV - SPECIAL PROTECTION INFORMATION

VENTILATION:

IF CURRENT VENTILATION PRACTICES ARE NOT ADEQUATE TO MAINTAIN AIRBORNE CONCENTRATIONS BELOW THE ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), ADDITIONAL VENTILATION OR EXHAUST SYSTEMS MAY BE REQUIRED. WHERE EXPLOSIVE MIXTURES MAY BE PRESENT, ELECTRICAL SYSTEMS SAFE FOR SUCH LOCATIONS MUST BE USED.

RESPIRATORY PROTECTION:

IF AIRBORNE CONCENTRATIONS EXCEED ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), USE A SUPPLIED AIR RESPIRATOR. DO NOT USE A CHEMICAL CARTRIDGE RESPIRATOR.

PROTECTIVE GLOVES:

THE USE OF GLOVES IMPERMEABLE TO THE SPECIFIC MATERIAL HANDLED IS ADVISED TO PREVENT SKIN CONTACT, POSSIBLE IRRITATION AND ABSORPTION.

EYE PROTECTION:

APPROVED EYE PROTECTION TO SAFEGUARD AGAINST POTENTIAL EYE CONTACT, IRRITATION OR INJURY IS RECOMMENDED.

OTHER PROTECTIVE EQUIPMENT:

IT IS SUGGESTED THAT A SOURCE OF CLEAN WATER BE AVAILABLE IN THE WORK AREA FOR FLUSHING EYES AND SKIN. IMPERVIOUS CLOTHING SHOULD BE WORN AS NEEDED.

SECTION V - REACTIVITY DATA

STABILITY:

STABLE UNDER NORMAL CONDITIONS OF STORAGE AND HANDLING.

CONDITIONS TO AVOID (STABILITY):

AVOID ALL POSSIBLE SOURCES OF IGNITION (SEE SECTIONS VII AND VIII).

Product Name: METHANOL
Product Code No: 15030

SECTION V - REACTIVITY DATA

INCOMPATIBILITY (MATERIALS TO AVOID):

AVOID CONTACT WITH STRONG OXIDIZERS AND STRONG ACIDS AND BASES.

HAZARDOUS DECOMPOSITION PRODUCTS:

COMBUSTION MAY YIELD CARBON MONOXIDE AND/OR CARBON DIOXIDE. DO NOT BREATHE SMOKE OR FUMES. WEAR APPROPRIATE PROTECTIVE EQUIPMENT.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

POLYMERIZATION CONDITIONS TO AVOID:

NONE KNOWN

SECTION VI - SPILL AND LEAK PROCEDURES

HIGHWAY OR RAILWAY SPILLS
Call CHEMTREC (800) 424-9300 Cont. U.S.
(Collect) (202) 483-7616 from Alaska & Hawaii

PRECAUTIONS IN CASE OF RELEASE OR SPILL:

FLAMMABLE. KEEP ALL SOURCES OF IGNITION AND HOT METAL SURFACES AWAY FROM SPILL/RELEASE. STAY UPWIND AND AWAY FROM SPILL/RELEASE. ISOLATE HAZARD AREA AND LIMIT ENTRY TO EMERGENCY CREW. STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). PREVENT SPILLED MATERIAL FROM ENTERING SEWERS, STORM DRAINS, OTHER UNAUTHORIZED TREATMENT DRAINAGE SYSTEMS AND NATURAL WATERWAYS. DIKE FAR AHEAD OF SPILL FOR LATER RECOVERY OR DISPOSAL. SPILLED MATERIAL MAY BE ABSORBED INTO AN APPROPRIATE ABSORBENT MATERIAL. NOTIFY FIRE AUTHORITIES AND APPROPRIATE FEDERAL, STATE AND LOCAL AGENCIES. IMMEDIATE CLEANUP OF ANY SPILL IS RECOMMENDED. IF SPILL IN EXCESS OF EPA REPORTABLE QUANTITY IS MADE INTO THE ENVIRONMENT, IMMEDIATELY NOTIFY THE NATIONAL RESPONSE CENTER (PHONE NUMBER 800-424-8802).

EPA REPORTABLE QUANTITY:

METHANOL 5,000 lbs., EQUIVALENT TO 5,000 lbs. OF THIS PRODUCT.

WASTE DISPOSAL METHOD:

DISPOSE OF PRODUCT IN ACCORDANCE WITH LOCAL, COUNTY, STATE, AND FEDERAL REGULATIONS.

SECTION VII - STORAGE AND SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:

KEEP CONTAINER(S) TIGHTLY CLOSED. USE AND STORE THIS MATERIAL IN COOL, DRY, WELL VENTILATED AREAS AWAY FROM HEAT, DIRECT SUNLIGHT, HOT METAL SURFACES AND ALL SOURCES OF IGNITION. POST AREA "NO SMOKING OR OPEN FLAME." BOND AND GROUND ALL EQUIPMENT WHEN TRANSFERRING FROM ONE VESSEL TO ANOTHER. STORE ONLY IN APPROVED CONTAINERS. KEEP AWAY FROM INCOMPATIBLE MATERIALS (SEE SECTION V). PROTECT CONTAINER(S) AGAINST PHYSICAL DAMAGE. THE USE OF EXPLOSION-PROOF EQUIPMENT IS RECOMMENDED AND MAY BE REQUIRED (SEE APPROPRIATE FIRE CODES). DO NOT ENTER CONFINED SPACES SUCH AS TANKS OR PITS WITHOUT FOLLOWING PROPER ENTRY PROCEDURES SUCH AS ASTM D-4276. OUTDOOR OR DETACHED STORAGE IS PREFERRED. INDOOR STORAGE SHOULD MEET OSHA STANDARDS AND APPROPRIATE FIRE CODES. THE USE OF RESPIRATORY PROTECTION IS ADVISED WHEN CONCENTRATIONS EXCEED THE ESTABLISHED EXPOSURE LIMITS (SEE SECTIONS I AND IV). WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING OR SHOES. USE GOOD PERSONAL HYGIENE PRACTICE. "EMPTY" CONTAINERS RETAIN RESIDUE (LIQUID AND/OR VAPOR) AND CAN BE DANGEROUS. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS OR OTHER SOURCES OF IGNITION: THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. "EMPTY" DRUMS SHOULD BE COMPLETELY DRAINED, PROPERLY BUNGED AND PROMPTLY SHIPPED TO THE SUPPLIER OR A DRUM RECONDITIONER. ALL OTHER

SECTION VII - STORAGE AND SPECIAL PRECAUTIONS

CONTAINERS SHOULD BE DISPOSED OF IN AN ENVIRONMENTALLY SAFE MANNER AND IN ACCORDANCE WITH GOVERNMENTAL REGULATIONS. BEFORE WORKING ON OR IN TANKS WHICH CONTAIN OR HAVE CONTAINED THIS PRODUCT, REFER TO OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS, ANSI Z49.1, AND OTHER GOVERNMENTAL AND INDUSTRIAL REFERENCES PERTAINING TO CLEANING, REPAIRING, WELDING, OR OTHER CONTEMPLATED OPERATIONS.

SECTION VIII - FIRE AND EXPLOSION HAZARD DATA

			HAZARD RANKING	
NFPA HAZARD CLASS	HEALTH HAZARD:	1	0 = LEAST	FLASH POINT
	FLAMMABILITY:	3	1 = SLIGHT	
	REACTIVITY:	0	2 = MODERATE	52 F (TCC)
	OTHER:		3 = HIGH	
			4 = EXTREME	
			* = CHRONIC HEALTH EFFECTS	
HMIS HAZARD CLASS	HEALTH HAZARD:	2*		
	FLAMMABILITY:	3		
	REACTIVITY:	0		
	PPE:			

LOWER EXPLOSIVE LIMIT (% VOL.)	UPPER EXPLOSIVE LIMIT (% VOL.)
7.3	36.0

EXTINGUISHING MEDIA:

DRY CHEMICAL, CARBON DIOXIDE, HALON, POLAR OR ALCOHOL FOAM, OR WATER SPRAY IS RECOMMENDED. WATER MAY BE INEFFECTIVE.

UNUSUAL FIRE & EXPLOSION HAZARDS:

THIS MATERIAL IS FLAMMABLE AND MAY BE IGNITED BY HEAT, SPARKS, FLAME OR OTHER SOURCES OF IGNITION (e.g. STATIC ELECTRICITY, PILOT LIGHTS, MECHANICAL/ELECTRICAL EQUIPMENT). VAPORS MAY TRAVEL CONSIDERABLE DISTANCES TO A SOURCE OF IGNITION WHERE THEY MAY IGNITE, FLASHBACK OR EXPLODE. VAPOR/AIR EXPLOSION HAZARD INDOORS/OUTDOORS OR IN SEWERS. VAPORS ARE HEAVIER THAN AIR AND MAY ACCUMULATE IN LOW AREAS. IF CONTAINER IS NOT PROPERLY COOLED, IT MAY EXPLODE IN THE HEAT OF A FIRE.

SPECIAL FIRE FIGHTING PROCEDURES:

WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. MOVE UNDAMAGED CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. WATER SPRAY MAY BE USEFUL IN MINIMIZING OR DISPERSING VAPORS AND COOLING EQUIPMENT EXPOSED TO HEAT AND FLAME. AVOID SPREADING BURNING LIQUID WITH WATER USED FOR COOLING PURPOSES.

SECTION IX - PHYSICAL DATA

***UNLESS OTHERWISE NOTED, VALUES ARE AT 20 C/68 F AND 760 mm Hg/1 atm.

APPROX BOILING POINT	(AIR = 1) VAPOR DENSITY	(N-BUTYL ACETATE = 1) EVAPORATION RATE	% VOLATILE
148 F	1.1	3.50	100

% SOLUBILITY IN WATER	VAPOR PRESSURE (mm Hg)
100	96

SPECIFIC GRAVITY	APPROX. BULK DENSITY (lb/gal)
0.792 (60 F/60 F)	6.6 (60 F)

SECTION IX - PHYSICAL DATA

APPEARANCE

CLEAR, LITTLE IF ANY COLOR, LIQUID

ODOR

CHARACTERISTIC

SECTION X - PRECAUTIONARY WARNING

WARNING! FLAMMABLE. HARMFUL IF SWALLOWED. MAY CAUSE BLINDNESS IF SWALLOWED. CANNOT BE MADE NONPOISONOUS. KEEP AWAY FROM HEAT, SPARKS, FLAMES OR OTHER SOURCES OF IGNITION (E.G., STATIC ELECTRICITY, PILOT LIGHTS OR MECHANICAL/ELECTRICAL EQUIPMENT). DO NOT TASTE OR SWALLOW. WASH THOROUGHLY AFTER HANDLING. **POISON** CALL A PHYSICIAN. FIRST AID: IF SWALLOWED, AND VICTIM IS CONSCIOUS AND ALERT, INDUCE VOMITING, PREFERABLY BY GIVING SYRUP OF IPECAC, OR BY GENTLY PLACING TWO FINGERS IN THE BACK OF THE THROAT. IF VICTIM IS UNCONSCIOUS, DO NOT GIVE ANYTHING BY MOUTH. CALL A PHYSICIAN. IN CASE OF CONTACT, FLUSH EYES OR SKIN WITH PLENTY OF WATER. ** SKULL AND CROSSBONES

SECTION XI - DOCUMENTARY INFORMATION

ISSUE DATE: 12/01/89 PRODUCT CODE NO. 15030

PREV. DATE: 03/21/89 PREV. PROD. CODE NO. 5030

MSDS NO: 6276 PREV. MSDS NO: 810

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

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FOR FURTHER INFORMATION, CONTACT YOUR LOCAL SALES OFFICE

ATLANTA	(404) 934-0343 (800) 633-2362
BALTIMORE (Outside MD)	(301) 355-2737 (800) 638-7676
BIRMINGHAM (Outside AL) (Inside AL)	(205) 995-9776 (800) 328-1611 (800) 328-1610
CHARLOTTE (NC Only) (SC, GA, VA)	(704) 588-2633 (800) 532-6103 (800) 438-2968
CHICAGO	(312) 257-9300
CINCINNATI	(513) 422-0176
CLEVELAND	(216) 425-4600
DALLAS/FT.WRTH	(214) 298-8233
DETROIT	(313) 772-0870
HOUSTON	(713) 643-3517
KANSAS CITY	(816) 231-7600
LOS ANGELES	(714) 228-4700
MIAMI (FL Only) (FL Only)	(305) 634-2411 (800) 621-3841 (800) 282-0537
NASHVILLE (TN Only)	(615) 320-5474 (800) 325-7685
NY/NJ (NY Only)	(201) 574-9890 (800) 526-4376
PHILADELPHIA CONSHOHOCKEN	(215) 753-1903 (215) 828-1010
NEW ENGLAND	(401) 438-7240 (800) 523-0725
SAN FRANCISCO/ OAKLAND AREA	(415) 562-1976
TWIN CITIES	(612) 227-8020
WICHITA	(316) 838-3335

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MSDS No. A0008.m

MATERIAL SAFETY DATA SHEET

The Coastal Corporation

Coastal Oil New York, Inc.
Coastal Oil New England, Inc.
Coastal Fuels Marketing, Inc.
Coastal Mobile Refining Company
Coastal Derby Refining Company
Coastal Eagle Point Oil Company
Coastal Mart, Inc.
Coastal Refining & Marketing, Inc.
Coastal States Crude Gathering C
Coastal States Trading, Inc.
Coastal Unilube, Inc.
Coscol Marine Corporation
Coscol Petroleum Corporation
Pacific Refining Company
Western Fuel Oil Company
Coastal Fuel Terminals, Inc.

Address: 9 Greenway Plaza
Houston, TX 77046

Info Phone: (713) 877-1400
Emergency Phone: (713) 877-1400

PRODUCT IDENTIFICATION

Trade Name: Fuel Oil No. 2 Date Revised: 02-07-90

Synonyms: No. 2 Heating Oil, Fuel Chief 2
Chemical Name and/or Family Description: A complex mixture of paraffinic, olefinic, naphthenic and aromatic hydrocarbons. A distillate of low sulfur content.
DOT Hazard Class: Combustible liquid; NA 1993.

COMPOSITION

			Occupational Exposure Limits*			
Product	CAS Number	Wt%	PEL	TLV	Other	Units
Fuel Oil #2	68476-30-2	100	5	5	10 STEL	mg/m³**

* = 8-Hr. TWA unless otherwise specified.
** = As oil mist.
STEL = Short Term Exposure Limit; 15 minutes.

PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point @ 760 mmHg: 340-700°F
Vapor Pressure mmHg @ 20C: 1.6
Solubility in H20 %: Insoluble
Specific Gravity 60/60F: 0.87
% Volatile by Volume @ 20C: N.A.
Viscosity (method,temp): 2.0-3.6 @40C cSt
Appearance: Clear to light amber liquid.
Melting Point: -20°F
Vapor Density (Air=1): 8
pH: N.A.
Evaporation Rate (Butyl Acetate=1): 0.01
Odor: Mild petroleum odor

N.A. = Not Available

FIRE AND EXPLOSION DATA

Flash Point: 145°F (COC)
Flammable Limits in Air % by Vol. Lower: 0..52 Upper: 7.5
Autoignition Temperature: 495 °F
Extinguishing Media: Dry chemical, carbon dioxide, foam, and water spray.

Special Fire Fighting Procedure: Use a water spray to cool fire-exposed containers. Use a smothering technique for extinguishing fire of this combustible liquid. Do not use a forced water stream directly on oil fires as this will scatter the fire. Firefighters should wear self-contained breathing apparatus and full protective clothing.

Unusual Fire or Explosion Hazard: Flowing oil can be ignited by self-generated static electricity; Check for combustible vapors prior to and during welding and torch cutting on tanks and vessels.

REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur
Conditions to Avoid/Incompatability: Strong oxidizing agents, heat, spark, flame and build-up of static electricity.

Hazardous Decomposition Products: CO, CO_2, SO_2, reactive hydrocarbons.

HEALTH HAZARD DATA

Carcinogenicity: NTP: No IARC Monographs: No OSHA Regulated: No

Occupational Exposure Limits: See Composition section

Effects of Overexposure

Acute:

Eyes: Slight to moderate eye irritation.

Skin: Moderately to extremely irritating; causing redness, drying to burns or blistering of skin.

Inhalation: Irritating to mucous membranes and respiratory tract. Will produce symptoms of intoxication such as headache, dizziness nausea, vomiting and loss of coordination.

Ingestion: Stomach irritation, gastritis, mild excitation, loss of conciousness, convulsions, cyanosis, congestion and capillary hemorrhaging of the lung and internal organs. Aspiration hazard if vomiting occurs.

Chronic: Prolonged or repeated skin contact may cause dermatitis.

Additional Medical and Toxicological Information: May aggravate pre-existing dermatitis. Middle distillates have caused skin cancer and kidney damage in laboratory animals. The National Institute for Occupational Safety and Health (NIOSH), based on findings of carcinogenic and tumorigenic responses of mice and rats exposed to whole diesel exhaust, recommends that whole diesel exhaust be regarded as a "potential occupational carcinogen".

EMERGENCY FIRST AID PROCEDURES

Eye Contact: Flush thoroughly with water for at least 15 minutes. Get medical attention.

Skin Contact: Cool the exposed area immediately. Remove contaminated clothing. Immediately wash affected areas with soap and water.

Inhalation: Remove to fresh air. Apply artificial respiration if not breathing. Get medical attention.

Ingestion: Do not induce vomiting. If spontaneous vomiting occurs, hold the victim's head lower than hips to prevent aspiration.

SPECIAL PROTECTION INFORMATION

Eye Protection: Remove contact lenses and wear chemical safety glasses or goggles where contact with liquid or mist may occur.

Skin Protection: Wear impervious gloves when contact with skin may occur.

Inhalation: Use approved respiratory protective equipment for cleaning large spills or entry into large tanks, vessels or other confined spaces.

Ventilation: Provide adequate ventilation (1) to keep mist or vapors below occupational exposure limits, (2) to prevent the formation of explosive atmospheres and (3) to prevent oxygen deficient atmospheres, especially in confined spaces.

SPILL OR LEAK AND DISPOSAL PROCEDURES

Spill Procedures: Remove sources of heat or ignition including internal combustion engines and power tools. Clean-up spill, but do not flush to sewer or surface water. Ventilate area and avoid breathing vapors or mists.

Waste Disposal: Dispose through a licensed waste disposal company. Follow federal, state and local regulations.

SPECIAL PRECAUTIONS AND COMMENTS

Storage Requirements: Store in tightly closed containers in a dry cool place, away from sources of heat or ignition and incompatible substances. Ground and bond all transfer and storage equipment to prevent static sparks and equip with self closing valves, pressure vacuum bungs and flame arrestors. Empty containers may contain residue (liquid/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, flame, sparks or other sources of ignition; they may explode and cause injury or death.

SARA TITLE III INFORMATION

Section 311/312 Hazard Categorization

Acute	Chronic	Fire	Pressure	Reactive
X	X	X		

SARA Hazardous Substances

Ingredient	CAS No.	%, wt	Sec 313	Sec 302	RQ, lb	TPQ, lb

None Identified

Key: Sec 313 = Toxic Chemicals, Section 313
Sec 302 = Extremely Hazardous Substances (EHS), Section 302
RQ = Reportable Quantity of EHS
TPQ = Threshold Planning Quantity of EHS

CALIFORNIA PROPOSITION 65 WARNING

Chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm may be found in crude oil and petroleum products. Although it is possible to sufficiently refine a crude oil or its end products to remove the potential for cancer, we are advising that one or more of the listed chemicals may be present in some detectable quantities. Read and follow directions and use care when handling crude oil and petroleum products.

Industrial Hygiene Review: Delno D. Malzahn, CIH
Date Prepared: 10/07/85

MSDS No. A0007.msd

MATERIAL SAFETY DATA SHEET

The Coastal Corporation

Coastal Oil New York, Inc.
Coastal Oil New England, Inc.
Coastal Fuels Marketing, Inc.
Coastal Mobile Refining Company
Coastal Derby Refining Company
Coastal Eagle Point Oil Company
Coastal Mart, Inc.
Coastal Refining & Marketing, Inc.
Coastal States Crude Gathering Co.
Coastal States Trading, Inc.
Coastal Unilube, Inc.
Coscol Marine Corporation
Coscol Petroleum Corporation
Pacific Refining Company
Western Fuel Oil Company
Coastal Fuel Terminals, Inc.

Address: 9 Greenway Plaza
Houston, TX 77046

Info Phone: (713) 877-1400
Emergency Phone: (713) 877-1400

PRODUCT IDENTIFICATION

Trade Name: Fuel Oil No. 6 Date Revised: 02-07-90

Synonyms: Fuel Oil C, Bunker Fuel, Residual Fuel Oil
Chemical Name and/or Family Description: A complex mixture of paraffinic, olefinic, naphthenic and aromatic hydrocarbons. A distillate of crude oil of low sulfur content.
DOT Hazard Class: Combustible liquid; NA 1993.

COMPOSITION

			Occupational Exposure Limits*			
Product	CAS Number	Wt%	PEL	TLV	Other	Units
Fuel Oil 6	68553-00-4	100	5	5	10 STEL	mg/m³**

* = 8-Hr. TWA unless otherwise specified.
** = As oil mist.
STEL = Short Term Exposure Limit; 15 minutes.

PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point 760 mmHg: 500°F
Vapor Pressure mmHg @ 20C: 0.2
Solubility in H2O % : Insoluble
Specific Gravity 60/60F: 0.97
% Volatile by Volume @ 20 C: Negligible
Viscosity (method,temp): 150 @50C SFc
Appearance: Black liquid to heavy paste.

Melting Point: -20°F
Vapor Density (Air=1): 8
pH: N.A.
Evaporation Rate (n-Butyl Acetate = 1): 0.01
Odor: Mild petroleum odor

N.A. = Not Available

FIRE AND EXPLOSION DATA

Flash Point: 140°F (PMCC)
Flammable Limits in Air % by Vol. Lower: 1.0 Upper: 5.0
Autoignition Temperature: 765°F
Extinguishing Media: Dry chemical, carbon dioxide, foam, and water spray.

Special Fire Fighting Procedure: Use a water spray to cool fire-exposed containers. Use a smothering technique for extinguishing fire of this combustible liquid. Do not use a forced water stream directly on oil fires as this will scatter the fire. Firefighters should wear self-contained breathing apparatus and full protective clothing.

Unusual Fire or Explosion Hazard: Flowing oil can be ignited by self-generated static electricity; Check for combustible vapors prior to and during welding and torch cutting on tanks and vessels.

REACTIVITY DATA

Stability: Stable
Hazardous Polymerization: Will not occur.
Conditions to Avoid/Incompatability: Strong oxidizing agents, heat, spark, flame and build-up of static electricity.
Hazardous Decomposition Products: CO, CO_2, SO_2, reactive hydrocarbons.

HEALTH HAZARD DATA

Carcinogenicity: NTP: No IARC Monographs: No OSHA Regulated: No

Occupational Exposure Limits: See COMPOSITION section.

Effects of Overexposure

Acute:

Eyes: Slight to moderate eye irritation.

Skin: Moderately irritating; causing redness, drying of skin.

Inhalation: Irritating to mucous membranes and respiratory tract. Will produce symptoms of intoxication such as headache, dizziness, nausea, vomiting and loss of coordination.

Ingestion: Mild excitation, loss of conciousness, convulsions, cyanosis, congestion and capillary hemorrhaging of the lung and internal organs.

Chronic: Prolonged or repeated skin contact may cause dermatitis.

Additional Medical and Toxicological Information: May aggravate pre-existing dermatitis. Middle distillates have caused skin cancer and kidney damage in laboratory animals.

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SPECIAL PRECAUTIONS AND COMMENTS

Storage Requirements: Store in tightly closed containers in a dry cool place, away from sources of heat or ignition. Ground and bond all transfer and storage equipment to prevent static sparks and equip with self closing valves, pressure vacuum bungs and flame arrestors. Empty containers may contain residue (liquid/vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, flame, sparks, or other sources of ignition; they may explode and cause injury or death.

EPA SARA TITLE III INFORMATION

Section 311/312 Hazard Categorization

Acute	Chronic	Fire	Pressure	Reactive
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SARA Hazardous Substances

Ingredient	CAS No.	%, wt	Sec 313	Sec 302	RQ, lb	TPQ, lb
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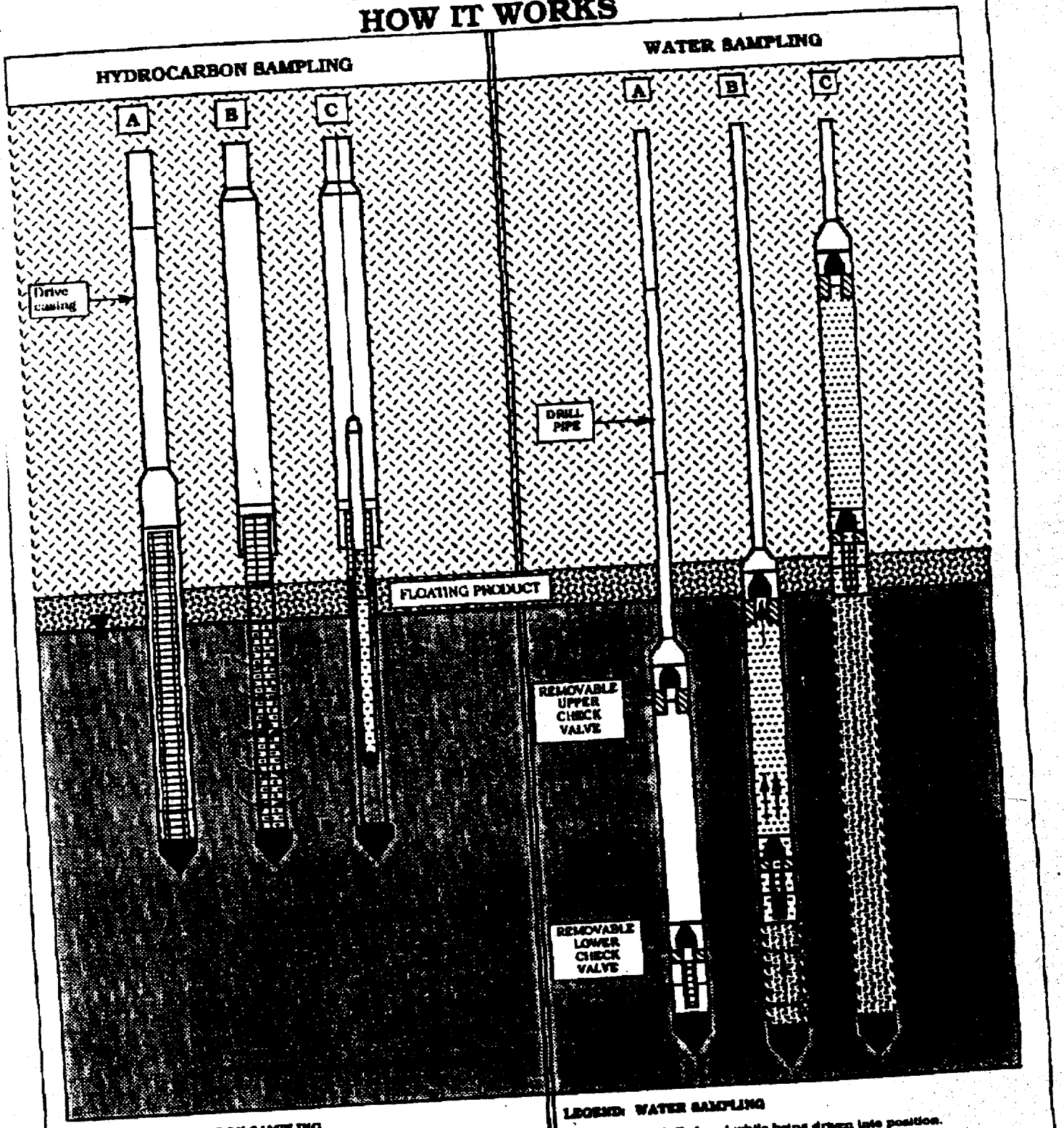
Industrial Hygiene Review: Delno D. Malzahn, CIH
Date Prepared: 10/07/85

Appendix E
Hydropunch II - How It Works

HYDROPUNCH II®
HOW IT WORKS



LEGEND: HYDROCARBON SAMPLING

A HydroPunch II closed while being driven into position.

B Tool opened and 5 foot screen telescopes into position for collection of hydrocarbon or water sample at the very top of the aquifer.

C Hydrocarbon sample being collected using bailer lowered through drive casing.

LEGEND: WATER SAMPLING

A HydroPunch II closed while being driven into position.

B Cone separated and tool open to collect sample.

C Check valves closed as sample is retrieved within body of the tool.

HOW THE HYDROPUNCH II® WORKS

The HydroPunch II is designed to be pushed or driven to the desired sample depth, either from the ground surface (in soft soils) or from the bottom of a drilled borehole (similar to a split barrel sampler). Typically this is accomplished by using a drill rig or a cone penetrometer rig. The tool utilizes an air-tight and water-tight sealed intake screen and sample chamber which is isolated from the surrounding environment as the tool is advanced.

The surface of the HydroPunch is designed to prevent the downward transport of contamination as the tool is advanced; it cleans itself as the soil particles are displaced to the side. A very tight annular seal is produced around the tool as the soil is displaced and compacts into the walls of the hole. The tight seal enables the HydroPunch II to collect a very discrete sample from a specific depth by sealing off ground water from above and below the zone to be sampled.

When the desired depth for collection of a sample is reached, the HydroPunch II is opened by pulling back on the body of the tool. Soil friction holds the drive cone in place as the body is pulled back. Once the HP-II is open and the O-ring seal between the drive cone and the body of the tool is broken, the tool fills from the bottom with no aeration and minimal agitation of the sample.

THE HYDROPUNCH II IS USED IN THE WATER SAMPLING MODE:

- if the sample can be collected from 5 feet or more below the top of the water table, and
- if 1.2 liters of sample volume is adequate.

When the tool is used in the water sampling mode, the sample is collected and transported to the surface within the body of the tool. As the tool is pulled upward, increased hydrostatic head closes a lower and upper check valve which retains the sample within the body of the HydroPunch. Once at the surface, the HydroPunch is inverted and the sample is decanted through a top discharge valve and tubing.

THE HYDROPUNCH II IS USED IN THE HYDROCARBON SAMPLING MODE:

- primarily, if a sample of floating product is needed;
- in special cases: if a ground water sample must come from the uppermost portion of the aquifer; if the water bearing strata are very thin; or if a large volume of sample is required.

When the HP-II is used in the hydrocarbon sampling mode the tool is connected to the surface using a hollow drive pipe of large enough inside diameter to permit the passage of a thin bailer. The sample is collected by lowering the bailer from the surface through the drive pipe and retrieving the sample. This configuration permits sampling of floating contaminants and also allows an unlimited quantity of sample to be collected. However, in this mode the sample is exposed to potential debris and water leakage from the entire length of drive pipe above it, making the procedure less suitable for low-level, sensitive sampling.